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BIOLOGY.—*Suggested terms for the interpretation of speciation phenomena.*[1]

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In the present state of systematic usage, there is a well-established tendency to revise nomenclature in order to fit in with the new concepts emanating from the laboratory and the field. However, the multitude of speciation phenomena emerging from these studies makes a simple trinomial system seem totally inadequate. Huxley's suggestion (1942, p. 410) about subsidiary terminologies which can be introduced to define "the cytogenetic and ecological data of systematics, and the facts concerning actual or potential interfertility," while still not interfering with the taxonomic convenience of the main terminology, seems a very wise one. A brief discussion of some of these terms follows here, with particular reference to current usage in ornithology. I am grateful to Dr. Herbert Friedmann for several valuable suggestions.

GENUS

The genus as a taxonomic term still lacks reality in genetic expression. We accept it as a valid category, however, realizing that it has reality in nature. The genus is being affected at the present time by speciation work on species problems. Wherever possible species are being combined and reduced in number. As a reflection of this, genera tend to follow suit. Generic names are being used nowadays to express degrees of relationship, a reversion to the Linnaean concept, rather than to express degrees of difference. The introduction of subspecies enables the species category to absorb part of the function previously held by the genus. As well as this the better understanding of the genetic basis for morphological differences tends to reduce the degree of importance formerly attached to obvious structural characters. As species become polytypic, so genera become increasingly polytypic in taxonomic usage, in order to maintain proportion. In ornithology the process of "tidying up" the arrangement of the genera of birds is now proceeding apace.

A definition of the genus as presently understood by speciation-minded ornithologists might read somewhat as follows: a natural catch basket which can be determined on morphological criteria but which so far eludes precise genetic analysis. This catch basket includes a group of species occupying different stages of relationship each to the other, but still apparently akin.

SUBGENUS

In the increasing cases where genera contain a large number of species some effort is usually made, by systematists of every hue, to provide subdivisions, higher than the species level, to define groups of species. Many systematists favor the use of a subgenus category. This is an orthodox category and should be adhered to if possible for convenience's sake. But what does it mean? Ridgway (1886) defines a subgenus as "a subdivision of a genus, of indefinite value, and frequently not recognized by name except in the grouping of species." In other words a subgenus can mean pretty much anything at all. If an author then is to use the term he should specifically define his use of it.

Mayr (1942, p. 290) suggests that subgenus if used in combination with genus, species, and subspecies amounts practically to

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a quadrinomial system as well as burdening the memory with an extra name to be remembered. He adds that the subgenus is used in ornithology either when an author does not quite dare to create a new genus in the face of growing opposition to such a procedure, or when he does not quite dare to sink an old well-established and well-known generic name. Another comment by Dunn (1943) is that since subgeneric names are indistinguishable from generic ones, there is a tendency for later authors to elevate them to generic rank. These remarks are possibly somewhat facetious, but they emphasize one aspect of the problem, that of the difficulty of the personal equation in authors. It is certainly true that the grouping of species into subgenera with their attendant lists of morphologic criteria, often irrelevant in plastic groups, seems a somewhat static way to list cognate species which are undergoing a dynamic process. I would urge then that plain subgenera not be used unless the particular category to which they belong is strictly defined.

OTHER TERMS

Several terms have arisen recently, some as a result of earlier theoretical work, for example, Kleinschmidt's "Formenkreis" carried further by Rensch, others in response to experimental evidence. Most of these terms are concerned with defining a natural monophyletic group lying somewhere between a species and a genus. Starting with that category most closely approaching the genus and listing them in descending order toward a straight species, we have the following:

(1) *Cenospecies.* Clausen, Keck, and Hiesey (1939) have tried hybridizing many plants belonging to the Compositae. They define cenospecies as those groups of species in which there is an absolute genetic barrier, although the ranges are similar or overlapping. This condition has not been well examined in animals except in *Drosophila* and may not be particularly common. Most closely related animal species seem to be able to produce viable and presumably reproducing hybrids, at least under artificial conditions.

(2) *Interspecies.*[2] I propose the use of the term *interspecies* to define a species group or sympatric subgenus, containing *a closely related group of geographically overlapping species which have attained physiological isolation in nature.* Such species may be monotypic or not. It does not affect the definition whether the species overlap only on the margins of their respective ranges, or whether one species is contained wholly within the range of another, i.e., double invasions of islands. This condition has previously been designated informally as a species group (Dice, 1940) for the deer mice, *Peromyscus*, where two species *leucopus* and *gossypinus* live side by side in part of their range without interbreeding although interfertile in the laboratory. Birckhead and myself (1942) used the term to describe the fruit pigeons of the *Ptilinopus purpuratus* assemblage on the Pacific islands. Similarly Mayr and myself (1941) used species group in discussing the Polynesian triller, *Lalage*, wherein two cases occurred of sympatric species obviously most closely related to each other. Diver (1940) discusses several such cases among plants, invertebrates, and insects. In the great majority of cases, it is at present impossible to prove whether two closely related animal species may be cenospecies or interspecies but this in no way invalidates the theory behind the terms. I can not think of two closely related bird species ever having been proved intersterile.

(3) *Superspecies.* Mayr (1931, p. 2) has proposed the term superspecies (instead of Rensch's "Artenkreis") for a systematic unit containing geographically representative species that have developed characters too distinct to permit the birds to be regarded as subspecies. This term symbolizes the next step but one above a simple polytypic species, containing units which have attained a degree of morphological difference implying reproductive isolation. I feel that Huxley (1942, pp. 179, 407) has confused the terminology somewhat by defining "Artenkreis" as equal to a geographical subgenus and restricting the use of superspecies (or supraspecies as it is sometimes mistakenly called) to intermediate situations in which the majority of forms of a

[2] *Inter-species*, species living among each other.

"Kreis" of allopatric groups are clearly subspecies of a polytypic species; "but a few have diverged further until they are probably or certainly regarded as separate monotypic species." This all seems to be an unnecessary complication, the necessity for which is eliminated by Mayr's amplification of his superspecies definition (1942, p. 169), to include both monotypic and polytypic members which are allopatric and are members of a monophyletic group. Thus geographical subgenus, allopatric subgenus, supraspecies, and the two terms of Clausen, Keck, and Hiesey (l.c.) for examples in plants, namely ecospecies and species complex, may be considered as names for a similar phenomenon as that expressed by superspecies. In the case of the last two terms, the difference between them is whether the species concerned show relative or absolute intersterility. As in the case of cenospecies this is a criterion which has not been proved to apply in the majority of closely related animal species.

Possible mechanisms for the successful maintenance of interspecies in contrast to simple geographical isolation in the case of superspecies have been suggested by several authors. Lack (1941) points out that habitat preferences may serve as a barrier once forms have remet after speciation has occurred. Diver (l.c.) concludes that as complete overlap in an ecological sense is presumably hardly ever present, "drift" or random differentiation in small partially isolated populations may be responsible. Actual psychological or physiological mating barriers are discussed by Dice (l.c.) and Diver (l.c., p. 326). Their relative importance in order to produce drift phenomena is probably great. Muller (1940) indicates the importance of isolation, even in partial degree, in producing effects of reduced fertility and viability after crossing.

The development of such a process is suggested by Huxley (l.c., p. 251) to be occurring among the grackles (*Quiscalus*) where a zone of hybridization between two subspecies increases steadily in area from southwest to northeast. This has a parallel in time, for the original hybridization must have occurred in the southwest and has spread to the northeast. Huxley suggests that the restriction of the hybrid zone at the original point of contact indicates a developing stabilization of the condition of selective disadvantage of the hybrid form. This may eventually be carried to the final stage of elimination of interbreeding, leading to the formation of an interspecies.

With the greater degree of speciation study now being applied in systematic groups, it seems likely that there will be an increasing discovery of cases of partially sympatric or even totally sympatric forms which for one reason or another have succeeded in evolving in spite of being most closely related to each other. It is likely also that in the world of the future with the breaking down, principally by the agency of man, of ecological barriers, more and more species will be thrown in direct contact with each other which previously were spatially isolated. An example of this occurs today on the island of Ceylon, where the extensive foresting and the wide spread of tea plantations with the development of new biotic conditions have disrupted the ranges of many species. Two closely related forms of the genera *Dicrurus* and *Gracula*, which Whistler (1944) calls in each case subspecies believing that they occur in separate ecological zones, have been found by me to occur in the same area without evidence of interbreeding. This is apparently a recent development as Whistler was depending on the early literature for his evidence rather than on newly collected material.

As classification and arrangement of forms in check lists, generic revisions, etc., proceed, it seems important to attain some method of indicating relationships. Some recent authors in ornithology (e.g., Mayr, 1941, and Delacour and Mayr, 1945) have introduced the superspecies concept into formal taxonomic lists. I feel that this procedure is welcome, but that in view of the present state of our knowledge it does not go far enough. It is obvious that geographical isolation is the cornerstone of much of the speciation process, but it is also obvious that physiological isolation as postulated by Dobzhansky (1940) is in

many cases a subsequent development which can result in allowing closely related species to live side by side. Thus to list only superspecies is to fail to give the complete picture of relationship. As an example, Mayr (1941, pp. 91–92) lists several species of kingfisher, including *Tanysiptera hydrocharis* and *T. galatea*. *T. galatea* is combined with several other species into a superspecies, but *T. hydrocharis* is left out because its range overlaps with *T. galatea* in southern New Guinea. Actually *T. hydrocharis* is most closely related to the latter species but has succeeded in attaining physiological isolation allowing it to live in the same area without hybridizing. Another example is the group of kingfisher species, *Halcyon chloris, sancta, cinnamomina, saurophaga, veneratus*, etc., figured by Mayr (1942, p. 181). Several examples in Delacour and Mayr's revision of the duck family (l.c., pp. 37–42) are also pertinent. Thus in the large genus *Dendrocygna, javanica, bicolor*, and *arcuata* are all intimately related, but *bicolor* and *arcuata* alone are bracketed as a superspecies. In the genus *Anas, bernieri* and *gibberifrons* are listed as one superspecies, *castanea* and *aucklandica* as another. And yet *castanea* and *gibberifrons* are so closely related from the morphological and distributional evidence available that were it not for an apparent overlap in their ranges they would be included as races of the same species. These two forms hybridize easily in captivity but apparently not in nature. Finally, in the genus *Aythya* the three species *valisneria, ferina*, and *americana* are all obviously of close relationship. However, geographical overlap prevents their being bracketed as a superspecies. In these cases I would include all the species in one interpsecies.

(4) *Emergent interspecies*. By this term I would define a species group containing a closely related group of geographically overlapping species with a marginal fringe of hybridization. Such a species group would normally include forms, one member of which at least tends to break up into geographical subspecies. Examples of this condition in birds are the woodpeckers *Colaptes auratus* and *cafer* (Huxley, l.c., p. 250), the crows *Corvus corone* and *cornix* (Meise, 1928), and the kingfishers *Ceyx erithacus* and *rufidorsus* (Ripley, 1942). Similar phenomena have been indicated among mammals (Banks, 1929, and Dice, l.c.), reptiles (Stull, 1940), fishes (Hubbs *et al.*, 1943), and insects (Carothers, 1941; Sweadner, 1937).

A special group of emergent interspecies are the cases where the terminal links in a chain of species or subspecies meet. A classic case is that of the gulls, *Larus argentatus* and *"fuscus"* figured by Mayr (1942, p. 180). Apparently there is a certain amount of interbreeding between the terminal links (vide Huxley l.c., p. 244). Another variation occurs in the creepers *Certhia familiaris* and *brachydactyla*, which behave like an interspecies except in the Caucasus where hybridization occurs. A further case of this sort occurs in the tits *Parus major* and *minor* as described by Rensch (1933), where hybridization occurs at certain zones of overlap, not at others.

Possibly the term semispecies of Mayr (1940) could be used to characterize cases such as those listed above. However, as defined by Mayr hybridization was not a criterion. Rather he used it to denote forms which "can be deduced to be geographical representatives of some other species, but have during isolation developed morphological differences of the order of magnitude to be seen between undoubted species." I believe that it would have been far more satisfactory to have defined semispecies with regard to the degree of interfertility rather than with regard to morphological difference by degree. Every taxonomist will have his own standard of degrees of morphological difference as between the category species or subspecies. Semispecies has thus been defined on the basis of a sliding scale.

SPECIES AND SUBSPECIES

Below these categories are species and subspecies which have been frequently and well defined in recent times. However, round the margins of species and subspecies hover cases which seem to be *in statu nascendi*. An example of a species in which two waves have met and hybridized so completely in nature that only one species can

be considered is *Pachycephala pectoralis* in the Solomon and Fiji Islands (Mayr, Amer. Mus. Novit. nos. 522, 531. 1932). This species contains two color forms: (a) with yellow underparts and (b) with white throat, which apparently represent two closely related waves of immigrants. If these waves had not been coextensive, but had remained representative, they would have been considered two well-marked species forming a superspecies. If, on the other hand, some of these forms had been discovered on the same islands without (due to the vagaries of field collecting) any evidence of hybridization, then there would have been no recourse but to consider them an interspecies. A small degree of interbreeding on the fringe of their ranges would have indicated a terminal condition serving to define the forms as an emergent interspecies. In this case, however, hybrizidation is too complete. Hybrid populations have been named and the apparent phenotypic differences have been proved to have little if any genotypic parallel. A somewhat similar example is found in the juncos (Miller, 1941).

It is to be hoped that all cases of this sort will in the future be fully discussed by biologists in order to emphasize the importance of studying these phenomena, both by laboratory and field workers. Only in this way will it be possible to define the speciation process.

SUMMARY

A number of terms are discussed by which various types of speciation may be described. It is suggested that these terms be used as an auxiliary to the main nomenclature of genus, species, and subspecies. It is further suggested that all evidence of unusual cases of speciation phenomena be pointed out and described by scientific writers in order to widen and extend the literature, and thus promote further study.

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ETHNOLOGY.—*Notes from Six Nations on the hunting and trapping of wild turkeys and passenger pigeons.*[1] ERNEST S. DODGE, Peabody Museum of Salem. (Communicated by WILLIAM N. FENTON.)

During the course of a field trip to Six Nations Reserve on Grand River, Ontario, in October 1944, most of the time was devoted to ethnozoological inquiries.[2] The following notes collected on the taking of wild turkeys [*Meleagris gallopavo silvestris* Vieillot] and passenger pigeons [*Ectopistes migratorius* (Linnaeus)] may be of some value, as the turkeys have been extirpated from the area for many years, and the pigeons, of course, are extinct. The data on the pigeons also supplement in a small way the recent study by Fenton and Deardorff. There are few persons living on the reserve old enough to remember the turkeys and pigeons. Because of lack of time and opportunity, inquiry could be made only among the Cayuga and the Munsee-Delaware, also residing on the reserve. This, however, resulted in some interesting contrasts between Iroquois and Algonkian hunting and trapping techniques.

Jerry Aaron, whose Cayuga name is *Sadegǫ'hes*, "Tall like the Trees," 78 years old, remembered that wild turkeys were hunted with the bow and arrow. Another Cayuga, Chief Alexander General or *Desga'heh*, "More than Eleven," corroborated this statement and said also that the Cayuga hunted them to the westward of the reserve before his parents' time.

Sadegǫ'hes told us of a hunting medicine used for approaching turkeys and other game. This medicine was made from a root of a plant, about as long as a man's finger, which the Cayuga call *wutunda'si*, but he could not remember the English name. The end of the root was burned and the resulting smut rubbed on the eyebrows, upper lip, inside of mouth, and on the palms of the hands of the hunter. The huntsman, thus equipped, could approach the turkeys closely as the powerful medicine caused them to stand still.

It is significant that neither of the Cayuga informants had ever heard of using any kind of a trap for catching turkeys.

Quite different from the Cayuga hunting was the Delaware trapping method recalled by Old Jessie Moses, about 80 years of age. He related that in the old days turkeys, called *pele'u* in Munsee, were caught in a trap made of poles driven into the ground with other poles fastened across the top and sides. It formed an enclosure or pen about 3 feet high and 6 or more feet square. The top was disguised with a sprinkling of dry leaves. One end had a low opening beneath the poles into which a trench led, excavated for a distance of about a rod, and sloping sufficiently to allow the birds to enter the pen beneath the lowest pole above the opening. The trench was made like a ramp. Leaves were spread bountifully in the runway and inside the pen. A small sprinkling of corn was put out leading from the woods to the ramp into the trap, and plenty of corn was put among the leaves inside the trap. The turkeys would come along feeding with their heads down and feed right into the trap. When they were through eating they would put their heads up and were imprisoned because they did not know enough to put them down again and find their way out at the place where they entered. Inevitably, in scratching for the corn among the leaves inside the pen, a deep litter of leaves would be backed around the palings and walls and cover the entrance.[3]

Young Jessie Moses, nephew of Old Jessie, said they also caught them with a pole at night when they were roosting. As the birds slept on the limb of a tree, the hunter with the end of a pole kept poking their feet. The disturbed birds would eventually step onto the pole and they could then be lowered to the ground and caught. The spurs of the old gobblers, he had heard,

[1] Received May 28, 1945.

[2] I am indebted to the Peabody Museum of Salem for supporting me on this field trip and to Dr. Frank G. Speck, whom I accompanied, and who has aided me in many ways.

[3] Dr. Speck found the knowledge of a similar pen type of trap surviving among the Delawares of Oklahoma, among the Cherokee of North Carolina, and the Powhatan (Rappahannock) bands of Tidewater Virginia.

were used for arrow points by the Delawares.

Additional Algonkian data from a different area were furnished by Chief Abe Spencer, age 81, a Chippewa, residing at the adjacent Missisauga Reserve. Like the Cayuga, he said that turkeys were shot with bows and arrows and later with guns, but he did not remember hearing of pen traps being used.

Few memories of pigeon hunting exist at Six Nations. The name for the bird, however, was readily recalled by the Cayuga as *tcahko'wa*, and by the Mohawk as *ori·'te*. *Desga'heh*[4] had vivid memories of stories heard from his grandmother about Cayuga passenger pigeon hunts. In his grandmother's time there was a district, about 10 miles west of the Reserve in the vicinity of the present Newtown (*Kana'tasę*) (Ca.), where the pigeons nested in great numbers. At that time the district was covered with pines and white cedars, but it has long since been converted to farmland.

According to *Desga'heh* the Cayuga took the pigeons at night by climbing the trees and removing the young from the nests. Adults were never taken and the white man's method of netting was never used.[5]

After each night of hunting the squabs collected were split and hung in the sun to dry. Thus cured, they were taken back to the reserve where they made superior eating, sometimes well into the winter months. These dried birds were always cooked, before being eaten, in one of several different ways—fried, roasted, or made into soup—and were considered excellent.

The Cayuga did not salt birds and pack them in barrels until shown how by the whites, after which time they began to take the adult birds as well as the nestlings, and market them in barrels, but despite these changes the white man's custom of netting was never adopted. It was thought that they were sometimes salted down in elm bark containers for the Indians own use.

The hunts were conducted by large parties and during the evenings there were social times and dances, but *Desga'heh* could not remember any of the details about these; nor could he recall hearing that Pigeon Dance was performed.

Among the Munsee-Delaware there was but little remembrance of the wild pigeon. Old Jessie Moses could give no details of hunting methods but recalled that only the young were taken and remembered catching a wild pigeon once himself at the age of eight.

Chief Abe Spencer, of the Missisauga Reserve, remembered that the Chippewa shot adult wild pigeons with bows and arrows, and also took the young from the nests. He also remembered seeing and hunting pigeons as a boy but could not recall the details.[6]

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[4] Mitchell (1935, p. 62) writing on the pigeon in Ontario, gives the Potawatomi, Chippewa, and Cree names for the pigeon but does not refer to the Iroquois names in the Province.

[5] Fenton and Deardorff (1943, p. 290) cite a Cayuga netting device from Grand River recorded by Waugh in 1918, but it was unknown to the informants we questioned.

[6] Mitchell (1935, p. 113) cites a correspondent to *Forest and Stream* who described New York State Indians shooting pigeons with bows and arrows rather than guns in 1823. (This reference reprinted from the original by Fenton and Deardorff. 1943, pp. 293–294.)

BOTANY.—*Scab of* Cinchona *in South America caused by* Elsinoë.[1] ANNA E. JENKINS, U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering.

The U. S. Board of Economic Warfare, later the Foreign Economic Administration, in charge of collecting strategic materials for the war effort, sent a group of botanists to Central and South America to examine existent stands of *Cinchona* and to determine which species would be suitable for harvest. Herbarium specimens were preserved as vouchers for bark samples analyzed and for future botanical work. On a survey in Colombia, obviously diseased fruits of *C. pubescens* Vahl were found on February 11, 1943, at Lavaderos, near San Agustín, Dept. de Huila, by Dr. F. R. Fosberg. The same capsule deformation was again observed in the Department of Nariño in October 1943. On this occasion Fosberg was accompanied by W. C. Davis, plant pathologist, then on an official mission of the Office of Foreign Agricultural Relations to Colombia. Representative specimens from three different trees (*Davis* 28, 29, and 30, corresponding to *Fosberg* 21255, 21283, and 21281), were referred to the writer for examination upon Davis's return to the United States late in 1943. Laboratory study revealed that capsules, leaves, and young stems were abundantly infected by a fungus of the genus *Elsinoë*. Following Fosberg's recent return to the United States and the receipt of his specimens here, he placed his ample gathering from the tree at Lavaderos (*Fosberg* 20065) at the writer's disposal for study and also permitted her to select part of it for mycological herbarium record (*Fosberg* 20065a).

The symptoms of the disease herein described and the diagnosis of the pathogen as a new species of *Elsinoë* are based particularly on the Davis and Fosberg dry herbarium specimens just mentioned.

Based on his observations during botanical surveys for *Cinchona* in Colombia, Ecuador, and Peru, Fosberg has furnished a general statement relative to the range of the scab in this part of South America, as follows:

"The disease is distributed practically throughout the range of *C. pubescens* in Colombia, i.e., throughout the three Cordilleras of the western half of the country; moreover, a collection of *C. pubescens* and one of *C. delessertiana* Standley from Peru show the same symptoms. Although symptoms of the scab have been looked for on *C. officinalis* L., they have been noticed only on trees of this species in the Coromoro area, east of Charalá and near Florian, both in the Department of Santander, Colombia. In the nursery at Popayán, Cauca, situated among trees affected with the disease, seedlings of the succirubra form of *C. pubescens* were unaffected. In Ecuador the disease was not noted on wild plants of this variety, nor on half a million seedlings growing under nursery conditions."

Typical lesions of the disease are present on botanial specimens collected by Pennell and Killip in the Department of Cauca, Colombia, in 1922 (cf. "Specimens examined," p. 350).

The disease under discussion, being hyperplastic in nature, is here termed "scab of *Cinchona*." This is in accordance with the nomenclature suggested elsewhere (12) for diseases of this type caused by *Elsinoë*, or by *Sphaceloma* De Bary (1, 17) in which form genus they are classified when only the conidial stage is known (cf. 16, p. 307, and 17).

It is impossible at this time to make a statement relative to the actual or potential economic importance of scab of *Cinchona*. Since leaves and young stems are affected (Fig. 2), it is possible that the disease might prove destructive if it were present in the nursery under conditions favorable for its development.

Leaf spot.—On leaves the spots are comparatively few to extremely numerous and may be scattered over a greater or less area of the blade or concentrated on or near the veins; occasionally they are aggregated near the leaf margin (Fig. 1, *A;* Fig. 2, *A*, *E*, and *F*). They are often circular to subcircular but may be elliptical to oblong or irregular, particularly when involving the veins (Fig. 2, *B* and *G;* Fig. 3, *D*).

[1] Received August 29, 1945.

Lesions are raised, dome-shaped, or flattened (Fig. 2, *A* and *B*); in some cases the central part of the spot is marked by an apiculus (Fig. 2, *B*, *b*, and *C*). Where spots are closely grouped, a few may coalesce (Fig. 3, *D*). Abundant infection on veins and midrib results in crowded or extensive coalesced lesions along these structures (Fig. 2, *E*, *F*, and *G*). In general the spots are 0.5 to 1.5 mm, rarely 2 mm, in diameter.

Lesions prominent on the upper leaf surface are often "cinnamon-drab."[2] Where mostly covered by fructifications of the fungus as in Fig. 2, *A*, *a*, they are "dark vinaceous-brown." The coloration of the particular lesion shown in Fig. 2, *A*, *b*, enlarged in *B*, *b*, and *C*, is as follows: Light area around the central apiculus "ecru drab," this surrounded by a "blackish brown" zone constituting a palisade of conidiophores of the pathogen (*Elsinoë*), rim of the platformlike spot where not fungus covered "light brownish drab"; finally, narrow discolored zone surrounding the elevation "dark vinaceous-brown." Where lesions are almost too small to be detected without magnification, the dark surrounding zone assists in marking their position (Fig. 1, *A*). Spots originating on the upper leaf surface are apparent on the pubescent lower side of the blade chiefly as faint vinaceous discolorations. Lesions originating below often are "vinaceous to brown." In this case the lesions form short conical to flattened elevations not uncommonly apiculate; on the upper side of the blade they appear merely as pocklike depressions. Occasionally spots fall away leaving the leaf perforated or with only a transparent network of tissue. The pathological histology of the lesion, which is hyperplastic in nature (see Fig. 3, *E*), corresponds closely to that of sour orange scab, caused by *Elsinoë fawcetti* Bitancourt and Jenkins (4) as carefully depicted by Cunningham (9).

Stem cankers.—Cankers on young stems, as well as on rachis and branches of the inflorescence, may be present in greater or less numbers over a given area, being distributed over all or only part of the circumference. On *Davis* 28 stem cankers are mostly elliptical, or irregularly so, reaching 4 by 5 mm in diameter. Those in close proximity may coalesce, although ordinarily the outline of the original lesion may be followed. Cankers are raised, with rounded to flattened surfaces usually accented by a small central apiculus, smooth as though polished. The main surface of the canker may be longitudinally or concentrically roughened; also, there may be fissures, particularly at the upper and lower margins. The cankers just described (Fig. 2, *D*) are "cinnamon-drab" as compared with the "dark vinaceous-brown" of the stem. Scalelike cankers on a rachis of *Fosberg* 20065 (Fig. 3, *A*, *a*, and *B*) are concolorous with the healthy stem.

Capsule lesions.—Practically all the many fruits on a single inflorescence may be affected by the scab as exemplified by the several complete inflorescences of *Fosberg* 20065 (Fig. 1, *A–C*; Fig. 3, *A*) and by the Pennell and Killip botanical specimens already mentioned. As alluded to previously, it was during the gathering of his no. 20065 that Fosberg's attention was attracted to the diseased condition of the capsules. The striking symptom noted in the field was that, instead of being straight or nearly so, capsules were abnormally curved, at times forming a crescent or practically a circle (Fig. 1, *B*, *a*, and *C*, *a;* Fig. 3, *A*, *a* and *b*) or were otherwise bent and distorted. Such severely affected fruit also may be dwarfed as the specimens show. It is probable that young capsules severely attacked fail to develop or soon fall away.

On capsules, lesions are often particularly numerous as well as generally more conspicuous than on leaves and stems. They are circular to elliptical, ranging from 1 mm or less to 3 mm in diameter, or elongate. Because of their large numbers or extensive coalescence they may occupy much of the capsule surface (Fig. 1, *A–C;* Fig. 3, *A*, *a* and *b*). On this substrate the spots are, as usual, raised, short conic or flattened; the apiculation already described in the case of leaf and stem lesions may be present. On the dry capsules of *Fosberg* 20065, spots appear as "wood brown" encrustations contrasting

[2] Names of colors in quotation marks are from "Color Standards and Color Nomenclature," by Robert Ridgway (1912).

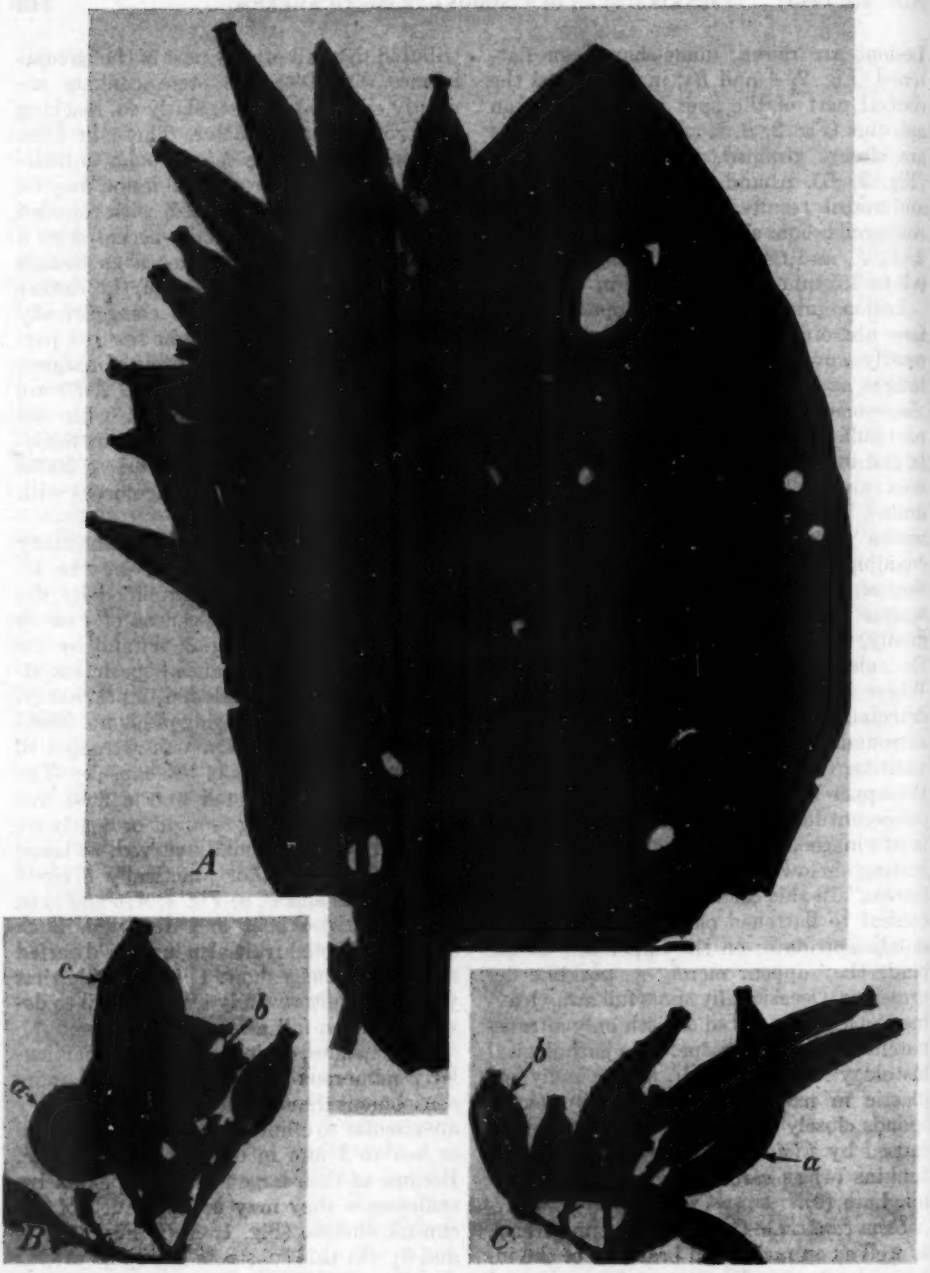

FIG. 1.—Scab on *Cinchona pubescens*, Lavaderos, Colombia, February 11, 1943, *F. R. Fosberg* 20065a: *A*, Part of panicle with numerous cankers on capsules; also leaf with many spots, the greater number clustered on or near midrib and veins and practically all too small to be viewed adequately without magnification, ×1; *B*, *C*, terminal parts of another inflorescence showing abundantly infected fruits; *a*, capsules curved out of normal position; *b*, open capsules showing healthy endocarp; *c*, pericarp of open capsule roughened by the numerous small, in part confluent, lesions covering most of the surface; ×1. Photograph by R. L. Taylor.

FIG. 2.—Leaf spots and stem cankers of the scab on *Cinchona pubescens*, *A–E*, vic. Chachagui, Colombia, October 16, 1943, *W. C. Davis* 28; *F* and *G*, La Unión, Colombia, October 21, 1943, *W. C. Davis* 29; *A*, *a*, *b*, Spotting prominent on upper side of the leaf; *c*, on lower surface of another blade, ×1; *B*, several raised spots from *A*, *a*, mostly darkened by the palisade of conidiophores of the pathogen (*Elsinoë*) over their surfaces (cf. Fig. 3, *E*), only outer zone covered in *a* and *b*, ×9; *C*, still greater detail of *A*, *b*, ×14; *D*, prominent cankers on young stem, ×1; *E*, *F*, continual vein infection on (*E*) lower surface of a comparatively young leaf, and (*F*) on upper surface of an older leaf, both ×1; *G*, detail of *F*, in the region of *a*; in the original specimen, dark, punctate masses, fructifications of the pathogen, scattered over the surface of the lesion, are best seen in the region of *G*, *a*, ×6. Photographs by M. L. F. Foubert (*A–E*) and by Taylor (*F* and *G*).

sharply with the "sorghum brown" of the smooth unaffected surface. In some cases capsule lesions are not distinguished by their color and, where of small size, would ordinarily be overlooked.

Prominent signs of the scab, visible as seen through a hand lens, are the dark more or less even covering over the entire or outer zone (see Fig. 2, *A* and *B*) of leaf spots, composed of a palisade layer of conidiophores of the pathogen (*Elsinoë*) (Fig. 2, *B* and *C;* Fig. 3, *E* and *F*) and dark pulvinate masses often occupying the central area of the leaf spot, these being ascomata of the pathogen (Fig. 3, *D*, and inset). Less conspicuous signs are smaller dark pulvinate masses, fructifications of the pathogen, on midrib lesions (cf. Fig. 2, *G*, legend for *a*), on stem cankers (Fig. 3, *B*, *a*), and on capsule lesions (Fig. 3, *C*, *a*).

Etiology.—On the basis of its morphology the pathogen of *Cinchona* scab belongs to the genus *Elsinoë* Raciborski (17, 20) of the myriangiaceous family Elsinoaceae. Historical sketches of this genus and family are available elsewhere (for example, cf. 10, pp. 5–8; 16, pp. 306–308). So far as can be determined at present the species on *Cinchona* has not been described hitherto; a diagnosis under a new name is therefore here presented as follows:

Elsinoë cinchonae, n. sp.

Producing few to numerous spots scattered over leaves, stems, and fruit; leaf spots occurring singly or in small groups, sometimes confluent; particularly along veins circular to subcircular, sometimes elliptical to oblong or irregular, raised with rounded or flattened surface, occasionally with a central apiculus, minute to 1.5 mm, rarely 2 mm, in diameter, those originating on the upper leaf surface often "cinnamon-drab" and not uncommonly surrounded by a narrow or comparatively broad "dark vinaceous-brown" zone, those originating on the lower side of the leaf often "vinaceous-brown"; stem cankers mostly elliptical or nearly so, reaching 4 by 5 mm in diameter, sometimes crowded or coalescent, raised with rounded to flattened often roughened surfaces, at times with a central smooth apiculus, occasionally fissured, particularly at upper and lower margins, "cinnamon-drab," or concolorous with the stem; spots on capsules circular to elliptical or elongate, up to 3 mm or so in diameter, or elongate, sometimes confluent over large areas, raised, short conical or flattened, "wood brown" or sometimes concolorous with the healthy capsule surface; entire fruit may be variously deformed, often circular or crescent-shaped; ascomata scattered over the lesions as small raised dark to black punctate areas, most conspicuous as grouped on central area or margin of the leaf spot, round to elliptical, pulvinate, reaching as many as 300μ in diameter by 75μ in thickness, although usually much smaller, erumpent superficial, stroma light colored, dark epithecium, which may become ruptured as the ascoma develops, up to 10μ in thickness, fructification crowded with asci; asci spherical to ellipsoid, 18 to 28μ, with characteristically thickened wall, in upper part reaching 8μ in thickness; ascospores hyaline, 1- to 3-septate, reaching 15 by 15μ; conidial stage (*Sphaceloma*) well developed on leaf spot, there consisting of a more or less continuous layer of dark conidiophores arising from a light-colored stroma covering all or only the bordering zone of the lesion, at the margin raised to form a sporodochium, up to 50μ thick, marginal sporodochium sometimes tilted owing to the development of an ascoma beneath; conidiophores dark, cyclindrical, apex pointed, often 1-septate, 3.5–5 by 8–15μ; the few conidia seen, brown, elliptical or spiculate at one end, 4–5 by 8–10μ.

Maculae plerumque numerosissimae, conspersae, circulares, subcirculares, usque ellipticae, interdum elongatae, elevatae, centro saepe plus minusve apiculiformi, interdum aggregatae vel confluentes, in foliis amphigenae, interdum nervisequentibus, usque 1.5 mm, rare 2 mm, superne conspicuores et saepe cinnamonea-griseae, margine nigro-vinaceo-brunneo circumdatae, inferne vinaceo-brunneae; cancri in caulibus generaliter elliptici, usque 4×5 mm, avellanei, vel discolores, in capsulis usque 3 mm diameter, avellanei vel discolores; ascomata plus minusve numerosa, in maculis foliorum epigena conspicuoria, rotunda usque elliptica, pulvinata, exposita, usque 300μ diameter, 75μ crassa, superficialiter nigro-brunnea; epithecium fuscum, 10μ crassum; asci numerosi, sub-epithecio in regione stromatica hyaline distributi, globosi usque ellipsoidei, apice incrassati, 18–20μ diameter; ascosporae

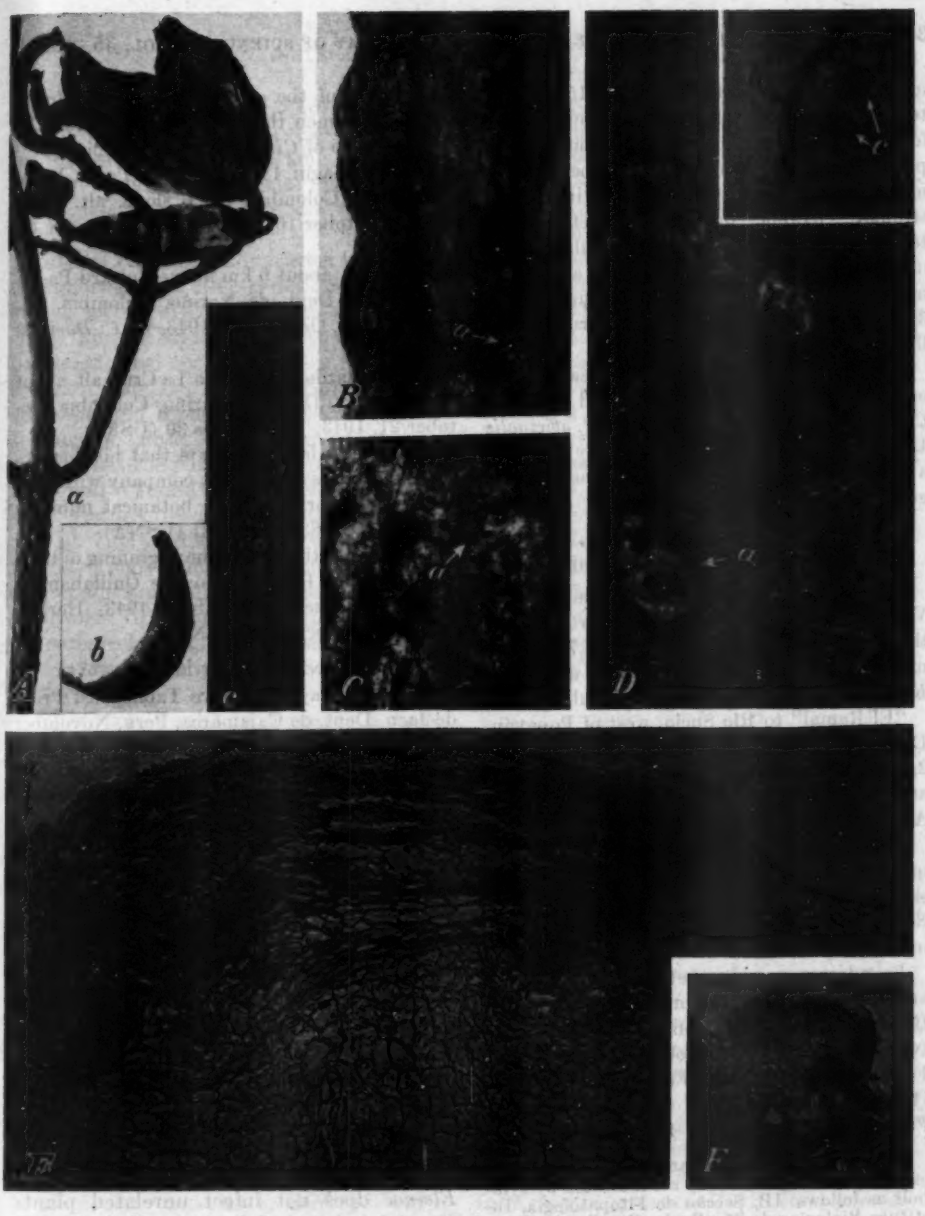

FIG. 3.—*A–D*, additional illustrations of the scab from *Fosberg* 20065 and 20065a: *A*, *a*, part of an inflorescence, with scalelike cankers on rachis; *b*, capsule abnormally crescent-shape, surface mostly covered with confluent lesions; *c*, leaf spots grouped near midrib, ×1; *B*, rachis cankers from *A*, *a*, fructifications of the *Elsinoë* on them barely visible as minute dark punctate masses (*a*); *C*, *a*, dark fructifications of the pathogen clearly distinguishable on lesions from capsule shown in *A*, *b*; *D* (exclusive of inset), leaf spots from *A*, *c*, with dark ascomata prominent on their surfaces; individual ascomata distinguishable on *a*. *B–D*, ×1; *D* (inset), photomicrograph showing part of an ascoma produced on margin of a lesion from *D*; *b*, epithecium; *c*, two asci with clear, thickened walls, ascospores, dark in photograph, stained red with erythrosin, *d*, epidermis of leaf. *E*, tangential section (unstained) through a leaf spot from Fig. 2, *A*, *a*, showing disorganized hyperplastic tissue of lesion and (*a* to *b*) conidiophore palisade over surface (cf. Fig. 2, *B* and *C*), ×125; *F*, *a*, sporodochium from another section, in comparable position to *E*, *b*, individual conidiophores distinguishable at right, ×225. Photographs by Taylor (*A–D*), Lilian Guernsey (*D*, inset), and by Foubert (*E* and *F*).

immaturae, 1–3-septatae, hyalinae, 15–5μ; status conidiophorus (*Sphaceloma*) in maculis foliorum epigenus prominens; condiophora in palum compactum, expositum superficialiter nigro-brunneum, plus minusve continuum, ex stromate hyaline oriundum, fructificatione tota 30μ crassa, vel marginem maculae versus usque 50μ; conidiophora cylindrica apice acuminato, generaliter continua vel uniseptata, 3.5–5 by 5–15μ; conidia rare visa, brunnea, elliptica, 4–5 by 8–10μ.

Distribution.—Producing the disease "scab of *Cinchona*" on leaves, stems, and fruits of *Cinchona pubescens* Vahl, rarely on *C. officinalis* L., in Colombia, Peru, and possibly Ecuador and on *C. delessertiana* in Peru. *Cinchona* is a genus of the family Rubiaceae.

Specimens examined:[3]

ON CINCHONA PUBESCENS VAHL

Cuatro Esquinas to Río Piendamo, Cauca Valley, Dept. de Cauca, Colombia, from tree in thicket growth ("machimbi"), alt. 1,700–1,900 meters, June 6, 1922, *F. W. Pennell* and *E. P. Killip* 6380 (US). Infection on capsules.

"El Ramal" to Río Sucio, west of Popayán, Dept. de Cauca, Colombia, woodland, alt. 2,000–2,200 meters. July 3, 1922, *F. W. Pennell* and *E. P. Killip* 8088 (US; also in NY). Abundant infection on the many capsules.

Barbosa, 22 km south, on road to Chiquinquira, Dept. de Santander, Colombia, roadside tree 6 meters high, January 4, 1943, *W. C. Steere* 7066 (US). Typical spotting on leaves, inflorescence branches, and on capsules.

Lavaderos, on ridge between Río Naranjo and Río Granadilla, 15 km south of San Agustín, Dept. de Huila, Colombia, in clearing between patches of moist woods, alt. 2,000 meters, February 11, 1943, *F. R. Fosberg* 20065a. Type (USM 90159, IB). This specimen is part of *Fosberg* 20065 (USNA). It was through his observation of the strikingly deformed fruits on this specimen that Fosberg discovered the disease "scab of *Cinchona*" in Colombia.

Vic. Chachagui, 18 km north of Pasto, Dept. de Nariño, Colombia, steep slope, alt. 2,100 meters, October 16, 1943, *W. C. Davis* 28 (USM, IB).

La Unión, about 6 km above, toward Pasto, along road, Dept. de Nariño, Colombia, alt. 2,010 meters, October 21, 1943, *W. C. Davis* 29 (USM).

San Bernardo, on trail to La Cruz, alt. about 2,200 meters, Dept. de Nariño, Colombia, October 21, 1943, *W. C. Davis* 30 (USM).

(The Davis labels indicate that his nos. 28, 29, and 30 were collected in company with Fosberg whose corresponding botanical numbers are 21255, 21283, and 21281 (USNA).

Urubamba River, near the beginning of trail, up to Machu Picchu, Prov. de Quillabamba, Dept. de Cuzco, Peru, June 1943, Hernan Augusto (*Hodge* 6201) (USNA).

ON CINCHONA DELESSERTIANA STANDLEY

Quebrada Pajonal, above Tabaconas, Prov. de Jaen, Dept. de Cajamarca, Peru, November 14, 1943, Earl Rogers s.n. (USNA).

ON CINCHONA OFFICINALIS L.

La Belleza, 10 km north of Florian, Dept. de Santander, Colombia, September 20, 1944, *N. C. Fassett* 25773 (USM). Fassett's regular botanical specimen from the tree bears his number 25772 (USNA).

Discussion.—*Elsinoë* species characteristically infect young growth of their suscepts. From the four species originally described (20), the group has grown, especially in recent years, until it is now admittedly large (cf. 3, pp. 512–513; 8, pp. 150–151; 16, table 1; 18, pp. 165–166), with suscepts ranging from the ferns to the composites. So far as has been determined by inoculation tests, a particular species of *Elsinoë* does not infect unrelated plants (for example, cf. 14); instead, individual species are limited in their pathogenicity to closely related plants or even to a single species in a genus (for example, cf. 13). The example just cited describes inoculation tests on species of different legume genera with a culture of *E. phaseoli* Jenkins (13) from *Phaseolus lunatus* var. *macrocarpus* Benth. Three of the legume genera of the

[3] The herbaria in which are filed the specimens examined during this study are indicated by symbols as follows: IB, Seccão de Fitopatologia, Instituto Biologico de São Paulo, Brazil; NY, New York Botanical Garden, Bronx Park, New York, N. Y.; US, United States National Herbarium, Smithsonian Institution, Washington, D. C.; USM, Mycological Collections of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Plant Industry Station, Beltsville, Md.; USNA, United States National Arboretum, United States Department of Agriculture, Plant Industry Station, Beltsville, Md. The US, NY, and USNA specimens were collected as phanerogamic material and are so deposited.

experiment, other than *Phaseolus*, were known suscepts of other species of *Elsinoë*. In this series of inoculations, which included several commercial varieties of *P. vulgaris* L., only *P. lunatus* var. *macrocarpus* became infected.

Parallel cultural comparisons may serve to demonstrate a close genetic relationship among species of *Elsinoë* from suscept genera within the same family. An example of this is afforded by two species from rosaceous suscepts, i.e., *E. veneta* (Burk.) Jenkins on *Rubus* and *Sphaceloma rosarum* (Pass.). Jenkins on *Rosa*. It is here inferred, of course, that the perfect stage of *S. rosarum*, when and if found, will be referable to *Elsinoë*. As described and illustrated (11, p. 332, pl. 7, *A* and *C*), these two organisms were strikingly similar when cultured under like conditions, although they were also separable. In inoculation experiments on the same set of plants of *Rosa*, *S. rosarum* gave positive results, *E. veneta* negative (11, p. 334).

With such results as these as a background, it would seem that *E. cinchonae* may be limited to genera within the tribe to which *Cinchona* belongs, or even to the genus alone.

Among the Rubiaceae we find *Sphaceloma genipae* Bitancourt (2) described on *Genipa americana* L. and *Elsinoë puertoricensis* Jenkins and Bitancourt (19) on *Randia* spp. including *R. mitis* L. Both *Genipa* and *Randia* belong to another tribe of this family than does *Cinchona*. *E. cinchonae* in its conidial stage is probably to be distinguished morphologically from *S. genipae*. To compare the two critically, however, would require strictly comparable growth of each. For example, small hyaline conidia, such as are described for *S. genipae*, should be compared with similar hyaline conidia of *E. cinchonae;* these latter doubtless exist, although they were not seen during the present study. Conidia from cultures may be required for such a comparison, and after cultures are available still further special culturing (cf. 15, pp. 25–28, figs. 1–9) may be necessary to obtain conidia. It must be borne in mind also that conidia of *Elsinoë* may begin to swell as soon as formed and that this feature presents a real hazard in making species comparisons on the basis of conidial measurements. The diversity of characters in species referable to the form genus *Sphaceloma* has led to difficulties in their taxonomy, as has already been discussed (16, p. 307; 17). The general similarity of growth of these fungi in culture, together with the possibility of separating them by this means, has proved a valuable asset. Colored plates illustrating parallel cultural comparisons of this group are available elsewhere (6, pl. 22; 7, pl. 15; 15, pl. 3); a method of making original isolations by means of microtechnique also has been delineated in another connection (5, p. 134, pl. 18, *H–M*).

Fructifications of the perfect stage of species of *Elsinoë* may be sufficiently distinctive to differentiate them, although care must be exercised in making comparisons. It is not rare, for example, to find only immature ascospores, as in the case of the specimens of *E. cinchonae* examined. Naturally, under all the circumstances, the description of a newly discovered fungus of the genus *Elsinoë* as new, or its identification as a species previously described, may be more or less provisional. In this way it is possible to record taxonomically more of the new suscepts of *Elsinoë* and *Sphaceloma* that are constantly being discovered in various parts of the world than would otherwise be the case. As additional pertinent data are obtained appropriate revisions may be made.

As at present described, *E. cinchonae* and *E. puertoricensis* appear to be distinct species. *E. puertoricensis* has pulvinate as well as applanate ascomata, with an indefinite epithecium. Asci, not particularly crowded in the fertile stroma, are often distributed in one horizontal plane. In *E. cinchonae* only pulvinate or practically hemispherical ascomata have been seen; this more regular form may be accounted for by the better-developed epithecium, which in one instance had ruptured, exposing the underlying hyaline ascigerous stroma. In this species on *Cinchona* the fertile stroma is extremely crowded with asci, which are oriented in different planes.

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BOTANY.—*Accessory vascular bundles in* Murraya koenigii (*Linn.*) *Spreng.* (*Rutaceae: Aurantioideae*).[1]

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From time to time plant anatomists have reported the presence of "accessory," "free" or "unattached" vascular bundles in various floral parts of several plant families. Varying amounts of significance have been given them by investigators. Unattached bundles, which are amphiphloic, or concentric, are described by Arber (*1*) as occurring in the genera *Lunaria, Sisymbrium,* and *Raphanus* and are figured in petals of *Lunaria,* stamens of *Sisymbrium,* and ovule of *Raphanus.* These bundles are described as passing through an amphiphloic stage, finally becoming collateral by the time the petals are free.

Considerable study has been given the various members of the subfamily Aurantioideae in regard to the vascular systems of their flowers. Tillson and Bamford (*2*) studied the floral vascular anatomy of 94 species belonging to 29 genera of the Aurantioideae. They make no mention of accessory bundles in any of the genera or species they studied. Their observations showed that in the genus *Murraya,* including *M. koenigii,* the vascular bundles supplying the various floral parts arose individually from the central cylinder of vascular tissue in the pedicel and that there was no exchange of lateral branch bundles between floral parts.

Accessory bundles were mentioned as occurring in the flowers of the Eureka Lemon, a cultivated variety of *Citrus limon,* by Ford (*3*), and are described as several groups of small vascular traces below the sepals.

[1] Received October 1, 1945. Grateful acknowledgment is made to Dr. Walter T. Swingle for his suggestions in preparing this paper and to the Science Research Council of the University of Miami, Coral Gables, Fla., under whose sponsorship the work was conducted.

"Some of these are not attached below, but others diverge from the vascular cylinder about 3 mm below the bases of the sepals." Ford found that all these bundles extended into the lateral part of the sepals and called them accessory sepal traces. He noted that the provascular elements for these accessory traces are present as early in ontogeny as those of the other bundles of the receptacle and that those attached to the main dorsal sepal traces diverge from them while they are yet a part of the stele.

In connection with an anatomical study of the two commonly cultivated species of *Murraya*, *M. koenigii* and *M. paniculata*, it was found that one of the species, *M. paniculata*, had no accessory bundles, but both loose and attached accessory bundles were found in *M. koenigii*, as shown in this paper.

MATERIALS AND METHODS

The flowers of *M. koenigii* are small and white and are borne in terminal corymbs; sepals free, five in number, about 1 mm long; petals 4–6 mm long, five in number; ten stamens, the alternate ones shorter; the ovary, borne on a short cylindrical disk, is 2- or 3-celled. Flower buds, flowers, and young and mature fruits were collected principally from a large heavily flowering tree growing in Dr. David Fairchild's Kampong in Coconut Grove, Fla. This tree is described and figured by Swingle (*4*). The material was fixed in Formalin-Aceto-Alcohol and imbedded in paraffin. Cross and longitudinal serial sections were cut 10 microns thick and stained with a safranine and fast green staining combination.

OBSERVATIONS

In the pedicel below the base of the sepals, the vascular elements form a continuous cylinder of tissue enclosing the pith. As is the case with many woody stems, the xylem borders the pith on the inside of the stele, and the phloem elements are on the outside; these two tissues are separated by the vascular cambium. On the outside of the phloem a cylinder of elongated parenchyma cells, several cells in thickness, makes up the pericycle. Before and during flowering no lignification of the pericycle occurs, but during the development of the fruit many of these cells become sclerenchymatous fibers.

In the receptacle, bundles of vascular tissue diverge from the stele to supply the various floral parts. The five sepal bundles are the first of such bundles to diverge. These gradually ascend upward and outward away from the stele across the receptacle and then follow a lateral course at the base of the sepals, eventually forming the sepal midribs. As these five relatively large midrib bundles diverge, five bundle trace gaps are apparent in the stele. Just above the point where the sepal midribs begin to separate from the stele, and outside of the pericycle in the cortical parenchyma, the basal limits of loose accessory bundles may appear (Fig. 1), usually as one or two vertical annular vessels in the cortical parenchyma. These vessels are much smaller in diameter than the surrounding cortical parenchyma cells and are spaced approximately halfway between any two diverging sepal midrib bundles. When present their basal ends are always in this relative position in the receptacle.

The course of the unattached bundles is parallel to that of the main sepal bundles across the receptacle, extending upward and gradually outward about halfway across the cortex until on a level with the sepal base. Here they show a lateral course, and extend out into the sepal after branching one or more times. Some branches terminate in the receptacle near the sepal base; others extend to the lower outer edge of the sepal, these usually terminate near an oil gland (Fig. 2).

In mature flowers the largest number of xylem elements occurs in the bundles just as they begin to extend laterally from near the center of the cortex to the sepals. The elements at this point consist of two to four annular vessels and eight to ten spiral vessels, which are identical in appearance with the annular and spiral vessels of the primary xylem in the stele. From here downward the number diminishes rather rapidly, until at the lower end only one or two vessels can be observed; these are always annular in nature, spiral vessels appear higher up in the bundle. Directly below the lowest xylem a few elongated parenchyma cells are sometimes present; these extend downward directly beneath the last lignified vessel for 10 or 20 microns. Under-

neath these there are no evidences of provascular parenchyma, only the large, isodiametric cortical parenchyma cells.

In the portion of the bundle extending laterally the width in every case gradually diminished as the sepal base was ap-

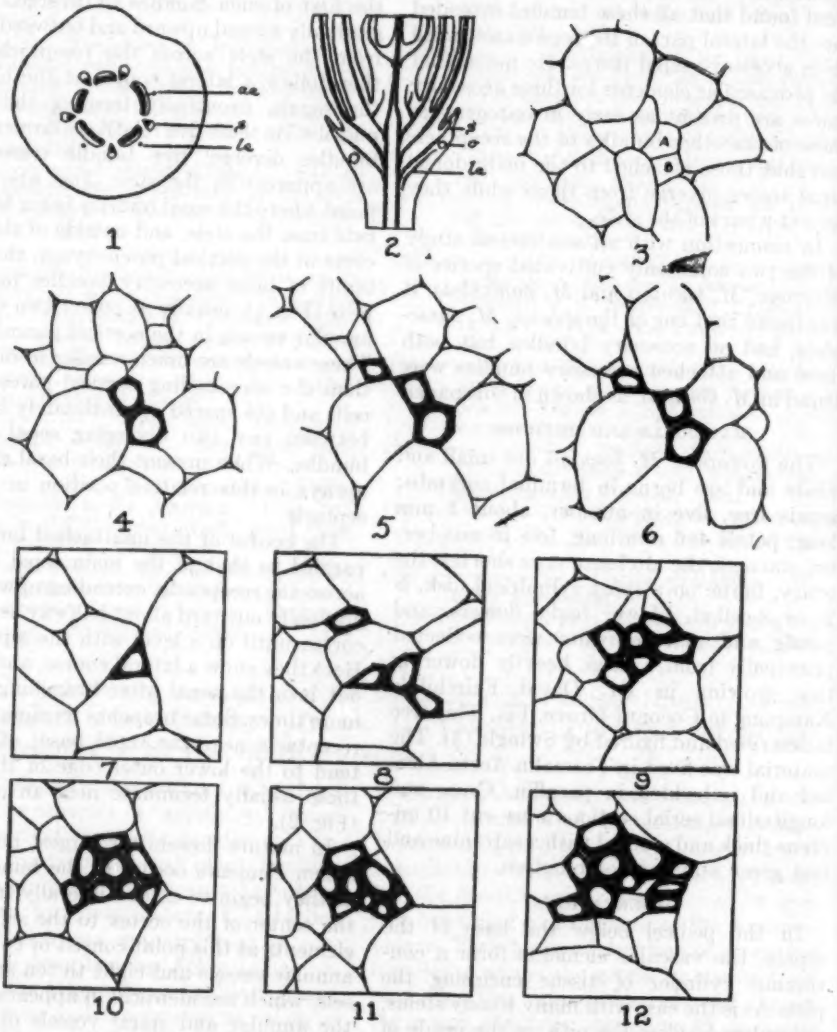

FIG. 1.—Diagram of cross section of the base of a flower at the point of origin of the accessory bundles: *aa*, attached accessory bundle; *s*, sepal midrib bundle; *la*, loose accessory bundle. FIG. 2.—Diagrammatic longitudinal view of base of a flower, showing position of a loose accessory bundle in relation to the main vascular system and floral parts: *s*, sepal midrib bundle; *o*, oil gland; *la*, loose accessory bundle. FIG. 3.—Arrangement of parenchyma cells 10μ beneath the lower limit of the loose accessory bundle shown in Fig. 4; cells A and B are elongated parenchyma cells beneath the two xylem elements shown in Fig. 4. FIGS. 4–6.—Three successive sections 10μ apart of the basal portion of a loose accessory bundle. FIGS. 7–12.—Six successive sections 10μ apart of the basal portion of a loose accessory bundle, showing the progressive increase in the number of xylem elements as the bundle ascends. (Fig. 1, ×30; Fig. 2, ×12; Figs. 3–12, ×550. FIGS. 4–6 are from slides S. & V. 57 B, Figs. 7–12 from slides S. & V. 57 I, in Univ. Miami Tropical Botany Histological Research Collection.)

proached. At this extremity not all the cells composing the bundles had become lignified, but these proxylem cells were easily distinguished from those of the cortical parenchyma, as they had very small diameters, dense cytoplasm, and were more elongate. The average length of 23 such bundles from their first appearance in the cortex to their ultimate termination was 0.475 mm.

Although xylem was well differentiated in the loose accessory bundles, no phloem or phloem parenchyma was observed in connection with them in *Murraya koenigii*. It is true that a few small parenchyma cells often exist in conjunction with the xylem in the large portion of the loose bundles, but near the basal portion of the bundles these cells were often lacking, and they were never numerous. Although smaller than most cells of the cortical parenchyma, they do not show the cell shape or elongation of the protophloem and metaphloem parenchyma of the stele, and of course they have no sieve plates. Rather, they seem to be small, irregularly isodiametric cortical parenchyma cells.

In addition to the loose accessory bundles some flowers have accessory bundles attached to the main vascular system. These appear in the receptacle at the same level as the lower limits of the loose bundles, but are connected with the vascular elements of the stele which form the petal midribs higher up in the receptacle. These attached bundles extend laterally across the cortex to the sepal bases, but describe a much shorter, flatter arc than the loose bundles, their average length being only 0.220 mm, or about half that of the loose bundles. Structurally they are similar to the loose accessory bundles, being composed of annular and spiral vessels, and apparently also lack phloem. The greatest number of elements in any one bundle occurs at a point about equidistant from the ends, and diminishes to only a few xylem elements at each end. At the base only three or four xylem elements are attached to the petal midrib.

Attached accessory bundles are not always present in any given flower, and no more than two attached accessory bundles were observed in any one of 22 flowers studied. Data concerning these flowers are listed in Table 1. It has not been determined whether the attached accessory bundles are branches of the petal midrib or bundles that arise independently and later continue to differentiate downward, ultimately connecting with the xylem of the stele. Studies of these bundles in young flower buds suggest this latter concept.

TABLE 1.—OCCURRENCE OF ACCESSORY BUNDLES IN 22 FLOWERS OF MURRAYA KOENIGII

Total accessory bundles per flower	Number of loose accessory bundles	Number of attached accessory bundles
0	—	—
0	—	—
1	1	—
1	1	—
1	1	—
2	—	2
2	1	1
2	1	1
2	1	1
2	2	—
2	2	—
2	2	—
2	2	—
2	2	—
2	2	—
2	2	—
3	2	1
3	3	—
3	3	—
4	3	1
4	4	—
5	5	—

The calyx is persistent after abscission of the petals and stamens and remains fresh and green during the development of the fruit. The calyx has reached its maturity when the petals and stamens are abscissed from the flower, as sections of the basal portions of mature fruits show its dimensions are no larger than they were in mature flowers. The loose and attached accessory bundles were no larger in these sections than in those of mature flowers; evidently they reach their maximum growth at the same time as the calyx.

The irregular occurrence of both the loose and attached accessory bundles in any given flower can not as yet be explained. It seems to have no relation to the position of the flower on the large much-branched terminal corymb, and no other features of the floral anatomy seem to be correlated with their occurrence or nonoccurrence.

Preliminary studies of serial microtome sections of flowers of other species of the Aurantioideae have shown that loose or attached accessory bundles or both occur in 16 species in both of the tribes 4 of the 6 subtribes, and 8 genera. These bundles show great diversity in structure, course, and branching from those described for *M. koenigii*. On the other hand, a very thorough study of several other species of the Aurantioideae has not disclosed a single accessory bundle.

SUMMARY

Although the vascular anatomy of the orange subfamily has been under study for over three-quarters of a century, Ford (*3*) was the first person to mention the presence of accessory bundles, which he described in the lemon. The present paper describes loose and attached accessory bundles which occur in the receptacle and calyx of *Murraya koenigii* and discusses their histology and relation to the main vascular system. It is pointed out that accessory vascular bundles are of widespread occurrence in the flowers of many other members of the subfamily Aurantioideae.

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ENTOMOLOGY.—*Concerning Neotropical Tingitidae (Hemiptera).*[1] C. J. Drake and E. J. Hambleton.

The present paper contains notes on 57 species of Neotropical Tingitidae, including the descriptions of two new genera and 22 new species. The types are in the Drake collection. The collections were made by E. J. Hambleton.

Family PIESMIDAE

Piesma cinerea (Say)

Los Cerritos, Guatemala, 18 specimens, taken on *Amaranthus*, July 5, 1944. This species is widely distributed, ranging from Canada south into Argentina.

Family TINGITIDAE

Subfamily Cantacaderinae

Phatnoma annulipes Champion

Turrialba, Costa Rica, 2 specimens, on *Vernonia* sp., August 13, 1944.

Subfamily Tingitinae

Monanthia c-nigrum Champion

El Porvenir, Guatemala, 7 specimens, July 9, 1944.

Monanthia loricata Distant

Villavicencio, Colombia, 50 specimens, November 3, 1944.

Monanthia berryi Drake

Machala, Ecuador, 14 specimens, Sept. 27, 1944. Recorded in the literature from Peru.

Monanthia monotropidia Stål

Tingo María, Peru, 3 specimens, September 14, 1944. Villavicencio, Colombia, 5 specimens, November 3, 1944, and San Andrés, El Salvador, 1 specimen, July 21, 1944.

Monanthia senta Drake and Hambleton

Salinas, Ecuador, 12 specimens, October 14, 1944; Machala, Ecuador, 6 specimens, September 27, 1944.

Monanthia pucallpana, n. sp.

Head black, shining, with five rather short, forward-directed, testaceous spines; eyes black. Antennae moderately long, indistinctly pilose; segment I short, slightly thickened, reddish brown; II slightly slenderer, reddish; III very slender, testaceous, about two and one-half times as long as IV; IV clavate, hairy. Bucculae broad, reticulated, closed in front. Rostrum moderately long, yellowish brown, extending to middle coxae. Legs moderately long, ferrugineous, the tibiae testaceous, the tarsi dark. Body beneath black.

[1] Received May 15, 1945.

Pronotum dark ferrugineous, moderately convex, coarsely pitted, tricarinate, lateral carinae short, present only on triangular process, slightly divaricating posteriorly; median carina more elevated, uniseriate, except posteriorly on triangular process; paranota moderately broad, completely reflexed, testaceous, not touching median carina, with three raised nervures; collar raised, reticulated, testaceous. Elytra ferrugineous, costal area mostly uniseriate, biseriate in widest part, testaceous, with some of the nervures infuscate, the areolae large and hyaline; discoidal area moderately large, with the posterior part of nervure separating it from subcostal strongly curved so as to form a C-shaped expansion in subcostal area, there with an oblique, raised line closing opening.

Length, 3.85 mm; width, 1.25 mm.

Type (male), allotype (female), and 14 paratypes, Pucallpa, Peru, September 5, 1944. This species is most closely related to *M. c-nigrum* Champion and *M. loricata* Distant but is easily separated from them by the wider paranota (roughened with raised, longitudinal lines) and the much wider costal area (biseriate in widest part).

Teleonemia quechua Monte

Aguaytia, Peru, September 10, 1944, 10 examples. Numerous other specimens are also at hand from Satipo, Cañete, Tingo María, Callauga, and Vilcanota, Peru. The many specimens exhibit some variation in size and color, and the male tends to be a little smaller than the female.

Teleonemia lanceolata (Walker)

Tingo María, Peru, 1 male, September 10, 1944. *T. albomarginata* Champion is a synonym of this species. It is widely distributed in Central and South America.

Teleonemia scrupulosa Stål

Villavicencio, Colombia, 1 male, November 3, 1944. The lantana lace bug is common in tropical America.

Teleonemia prolixa Stål

Pichilingue, Ecuador, 1 example, October 1–2, 1944.

Nyctotingis osborni Drake

Tingo María, Peru, 2 examples, from bamboo, September 10, 1944. These specimens are larger than the type and other specimens from Brazil, but there seems to be no structural differences.

Tingis abundans, n. sp.

Head brown, convex, with five testaceous spines; median spine moderately long, porrect; hind pair adpressed, long, the tips extending nearly to the base of antennae; front pair moderately long, directed forward; eyes large, black. Antennae very long, moderately slender, indistinctly pilose, testaceous, the terminal segment mostly black; segment I rather stout, moderately long, about three times as long as II; II slenderer, short; III very long, slender, straight, nearly three times as long as IV; IV moderately long, slightly thickened. Rostrum extending to intermediate coxae, the laminae more widely separated and convex within on metasternum. Body beneath brown. Legs moderately slender, testaceous. Bucculae broad, closed in front. Orifice present.

Pronotum moderately convex, pitted, yellowish brown, tricarinate, each carina composed of one row of tiny areolae; median carina more elevated on collar; lateral carinae almost parallel; paranota narrow, uniseriate, the margin finely serrate, calli distinct, brown. Elytra yellowish brown, a transverse band in front of middle fuscous, the nervures of sutural area more or less infuscate; costal area moderately broad, mostly uniseriate, in the widest part irregularly biseriate; subcostal area finely reticulated, mostly triseriate, quadriseriate in widest part; discoidal area narrow, extending to middle of elytra, widest behind middle, there four areolae deep. Wings longer than abdomen.

Length, 2.90 mm; width, 1.00 mm.

Type (male), allotype (female), and 11 paratypes, Pucallpa, Peru, September 5, 1944. Similar to *T. oliveirai* Drake and Hambleton and *T. saueri* Drake and Hambleton and separated from them by the higher carinae, longer cephalic spines, and more distinctly serrate margins of elytra.

Tingis gamboana, n. sp.

Differs from *T. abundans*, n. sp., by the biseriate costal area and narrower paranota. Pronotum brownish, becoming lighter posteriorly, finely pitted, tricarinate, moderately, transversely convex; lateral carinae low, dis-

tinct, nonareolated, median carina more raised, indistinctly reticulated; collar distinct, areolated; paranota very narrow, slightly wider in front. Head reddish fuscous, with five testaceous spines; median spine very short; front pair longer, directed forward, their tips touching; hind pair much longer, adpressed, extending a little beyond anterior margins of eyes. Antennae testaceous, indistinctly pilose, moderately long; segment I moderately thick, short, about twice as long as II; II slenderer, very short; III straight, about two and one-half times as long as IV; IV moderately long, mostly black.

Elytra testaceous, with a moderately broad, transverse, fuscous band near base; costal area rather broad, regularly biseriate; subcostal area wide, mostly quadriseriate; discoidal area reaching middle of elytra, widest a little before apex, there four areolae deep; sutural area with a spot (veinlet) near base and another before apex fuscous. Legs testaceous, the tips of tarsi dark. Rostrum extending a little beyond mesosternum. Wings almost as long as elytra. Body beneath black, shiny.

Length, 2.90 mm; width, 1.10 mm.

Type (female) and allotype (male), Gamboa, Canal Zone, Panama, on elm, November 16, 1944. The more strongly convex pronotum, much narrower paranota, and the distinct, transverse band of elytra separate this species from *T. saueri* Drake and Hambleton and *T. oliveirai* Drake and Hambleton. The lateral carinae are also lower and the margins of elytra and paranota indistinctly serrate.

Amblystira fuscitarsis Champion

Guatemala City, Guatemala, November 23, 1944, 85 specimens, from *Derris elliptica*. Known also from Panama, Colombia, Cuba, Haiti, and Brazil.

Amblystira pallipes Stål

Tingo María, Peru, September 7, 1944, 1 specimen, taken sweeping vegetation. Specimens are also at hand from Brazil, Colombia, and Venezuela.

Sphaerocysta nosella, n. sp.

Small, testaceous, the cysts dark fuscous, the pronotum dark ferrugineous. Pronotum moderately convex, finely pitted, tricarinate; carinae distinct, low, the lateral pair parallel, the median terminating behind in a small subconal cyst. Hood moderately large, narrowed anteriorly, wider than high, its greatest width and length about equal, some of the areolae subhyaline, paranota moderately wide, uniseriate, the areolae hyaline.

Elytra widest at base, thence moderately narrowed posteriorly. The outer margin broadly rounded; costal area wide, biseriate, the areolae clear, large, not arranged in very regular rows; sutural area with moderately large, clear areolae; cyst moderately large, inflated, very dark. Body beneath brown. Legs testaceous, rather slender, the tarsi dark. Rostrum extending on metasternum. Antennae testaceous, the terminal segment mostly brownish black; segment I moderately swollen, nearly twice as long as II, the latter short; III long, slender, indistinctly pilose, three times as long as IV, the latter thickened apically.

Length, 2.10 mm; width, 1.00 mm.

Type (male), allotype (female), and 9 paratypes, Vinces, Ecuador, October 14, 1944. It resembles *S. inflata* Drake but is much smaller with narrower and uniseriate paranota, blackish cysts, and slenderer legs and antennae. This is the smallest member of the genus, and the nervures are much more delicate.

Phaeochila, n. gen.

Pronotum moderately convex, narrowed anteriorly, clothed with fine, long hairs, pitted, tricarinate; collar distinct, raised at middle so as to form a small hood, there slightly projecting in front; paranota narrow, uniseriate; head smooth, with spines absent or greatly atrophied. Bucculae short, reticulated, contiguous in front. Rostral channel wide; rostrum moderately long. Orifice present. Hypocostal ridge uniseriate. Antennae rather long, moderately stout, pilose; segment I rather short, stouter and longer than II; III longest; IV slightly thicker than III, moderately long. Legs moderately long. Elytra divided in the usual divisions, with a distinct, inflated area a little behind middle of nervure separating discoidal and subcostal areas, indistinctly clothed with fine, very short hairs; discoidal area not reaching middle of elytra.

Type of genus, *Phaeochila hirta* (Monte) = *Amblystira hirta* Monte.

This genus is allied to the genus *Acanthocheila* Stål and may be separated from it by the tricarinate pronotum, absence of spines on

the margins of paranota and elytra. Separated from *Amblystira* Stål by the hood and tumid elevation of elytra; from *Sphaerocysta* Stål by the lack of pronotal cysts and shorter lateral carinae.

Phaeochila hirta (Monte)

Amblystira hirta Monte, Arq. Inst. Biol. 2: 284, fig. 5. 1940.

Pucallpa, Peru, 7 specimens, September 5, 1944. This is the first record of this interesting species in Peru.

Leptocysta sexnebulosa Stål

Villavicencio, Colombia, 1 female, November 3, 1944.

Acanthocheila dira, n. sp.

Similar to *A. armigera* Stål in size and general appearance. Head black, with a long, median, erect, testaceous spine; hind pair of spines long, testaceous, adpressed; extending beyond eyes; segment I brown, thick, narrowed at base, three times as long as II, II short, brownish, slender; III long, testaceous, slightly bent, three times as long as IV; IV moderately thickened, blackish, testaceous at base. Legs rather slender, pale stramineous, moderately hairy, the tips of tarsi dark. Rostrum brownish, dark at tip, reaching hind margin of mesosternum.

Body beneath black, shiny; abdomen in female wide, broadly expanded, wings a little longer than abdomen. Hemelytra much more sharply expanded near base than in *A. armigera*, testaceous, considerably embrowned at base; costal area mostly biseriate, with brownish band near base; discoidal area short, mostly four areolae deep; subcostal area broad, closely reticulated within opposite discoidal area. Pronotum unicarinate, transversely convex, pitted, brown; paranota very narrow, uniseriate, the outer margin armed with much longer spines than in *A. armigera*, the second, third and fourth spines sharply reflexed. Apex of hind triangular projection truncate.

Length, 3.25 mm; width, 1.75 mm.

Type (female), El Porvenir, Guatemala, July 9, 1944. Separated from *A. armigera* Stål by the very long, erect, median spine of head, very long marginal spines of paranota and the more sharply widened basal portion of elytra.

Acanthocheila armigera Stål

Many specimens, the commonest member of the genus; Tingo María, Peru, September 14, 1944, and Machala, Ecuador, September 27, 1944; Villavicencio, Colombia, November 3, 1944; El Porvenir, Guatemala, July 9, 1944.

Leptopharsa dapsilis, n. sp.

Elongate, rather broad, testaceous, the head and pronotum (except hind process) black. Head short, the spines greatly reduced; median and anterior pair represented by small tubercules; hind pair very slender, adpressed, testaceous. Antennae long, brown-fuscous, distinctly hairy; segment I moderately long, moderately thick, not quite three times as long as II; II short, slenderer; III straight, very slender, clothed with moderately long hairs, slightly more than three times as long as IV; IV moderately long, clothed with longer hairs, slightly thickened, black. Legs long, slender, dark brown; rostrum yellowish brown, dark at apex, extending a little beyond end of sulcus; rostral channel very wide, the laminae low. Bucculae testaceous, closed in front.

Pronotum moderately convex, pitted, tricarinate; median carina testaceous foliaceous, uniseriate, distinctly higher than lateral, the areolae moderately large; lateral carinae testaceous, rather short, terminating anteriorly at middle of disc, subparallel, uniseriate, the aerolae small. Hood subglobose, moderately large, testaceous, slightly projecting in front. Paranota testaceous, moderately large, moderately reflexed, the outer margin rounded, mostly biseriate, the areolae moderately large. Elytra moderately broad, testaceous; costal area broad, biseriate along basal portion, triseriate in widest part, the areolae large and hyaline; subcostal area narrow, mostly triseriate, the areolae small; discoidal area small, not reaching middle of elytra, considerably embrowned, narrowed at base and apex, widest behind middle, there four areolae deep; sutural area closely reticulated at base, there considerably embrowned. Wings extending a little beyond apex of abdomen.

Length, 3.95 mm; width, 1.55 mm.

Type (male), allotype (female), and 86 paratypes, from *Olmediella betschleriana* (Goepp.), Guatemala City, Guatemala, July 9, 1944. The shorter lateral carinae separate this species from all other members of the genus.

Leptopharsa deca, n. sp.

Differs from *L. usingeri* Drake in the biseri-

ate paranota, low carinae, differently formed hood, and fuscous apical portion of elytra. Antennae moderately long, slender, testaceous; segment I strongly incrassate, brownish, short, twice as long as II; II slender, slightly thicker than III, testaceous; III slenderest, about three times as long as IV; IV mostly brownish black, slightly thickened. Bucculae broad, meeting in front, testaceous, becoming brownish above. Rostrum extending beyond middle of mesosternum. Rostral laminae strongly foliaceous on mesosternum, narrowed posteriorly, the ends meeting behind; laminae lower on metasternum, cordate. Legs slender, testaceous, the tarsi darker. Head with moderately long, testaceous spines.

Hood rather large, a little longer in female than male, covering most of head, inflated, highest (crest) in front of center, slightly longer than high, higher than broad, the nervures embrowned. Paranota testaceous, biseriate, the areolae rather large, hyaline. Pronotum moderately convex, brown; carinae distinct, uniseriate, the areolae small, the lateral carinae slightly divaricating anteriorly. Elytra moderately broad, slightly constricted beyond middle, widest before apex, the tips separated in repose; costal area broad, mostly triseriate, quadriseriate in widest part, testaceous, the areolae large, clear; subcostal area finely areolated, brown, five areolae deep; discoidal area brown, not quite reaching middle of elytra; widest beyond middle, there five areolae deep, with a black-fuscous mark near middle of outer boundary; sutural area mostly clouded with fuscous, some of the apical areolae partly hyaline.

Length, 3.10 mm; width, 1.40 mm.

Type (male), allotype (female), and 3 paratypes, Pichilingue, Ecuador, October 1–2, 1944. The hood is much smaller, the first antennal segment much shorter and thicker, and the carinae much lower than in *L. praestantis* Drake. The meeting of the tips of the mesosternal laminae closes the rostral channel, but in a much different way structurally than in the genus *Gargaphia* Stål.

Leptopharsa ovantis, n. sp.

Differs from *L. furculata* (Champion) in having biseriate paranota, black-fuscous first antennal segment and slightly smaller hood. Color marking very similar to *L. furculata*. Antennae rather long, indistinctly pilose; segment I moderately long, moderately incrassate; three times as long as II; II short, slenderer, testaceous; III long, straight, testaceous, slightly more than twice as long as IV; IV rather long, mostly black, beset with long hairs. Legs slender, testaceous, other characters very similar to *L. furculata*.

Length, 3.75 mm; width, 1.75 mm.

Type (male), allotype (female), and 3 paratypes, Tingo María, Peru, September 7, 1944.

Leptopharsa angustata (Champion)

Barcena, Guatemala, many specimens, November 28, 1944.

Leptopharsa tenuis (Champion)

Barcena, Guatemala, many specimens, on *Ichthyomethia grandifolia* (Donn. Smith), November 28, 1944.

Leptopharsa laureata, n. sp.

Small, moderately elongate; body beneath brown to black. Rostrum long, extending to end of sulcus, testaceous, black at tip; rostral laminae testaceous, concave within on metasternum. Antennae rather long, slender, indistinctly pilose; segment I black-fuscous, moderately thick, about three times as long as II; II short, testaceous, slightly enlarged; III long, slender, testaceous, about two and one-half times as long as IV; IV mostly dark fuscous, moderately long. Legs long, slender, testaceous. Eyes black. Head black, with five moderately long spines; hind pair testaceous, adpressed; median spine brownish to black, turned downward.

Pronotum black, moderately, transversely convex, pitted; carinae testaceous, low indistinctly areolate, the lateral carinae slightly concave within on disc; paranota testaceous, biseriate, the outer margin rounded; hood small, inflated, slightly projecting in front. Elytra moderately broad, indistinctly serrate along outer margins; costal area testaceous, moderately wide, mostly biseriate, triseriate in widest part, the areolae clear and moderately large; subcostal area narrow, biseriate, the veins black-fuscous; discoidal area extending to middle of elytra, narrow, narrowed at base and apex, four areolae deep in widest part, the veins fuscous-black; sutural area more widely reticulated; the veins infuscate.

Length, 2.20 mm; width, 1.00 mm.

Type (male), allotype (female) and 11 paratypes, Pucallpa, Peru, September 5, 1944. Allied to *L. bondari* Drake and Poor from Brazil but separated from it by the longer rostrum, triseriate costal area in widest part and lower carinae, especially median. The lateral margins of the elytra also are more rounded.

Leptopharsa jubaris, n. sp.

Small, ovate, testaceous, the pronotum brownish. Head black, with rather short, testaceous spines; hind pair adpressed, the three frontal spines shorter, directed forward, sometimes adpressed. Rostrum brownish, extending to metasternum; metasternal laminae cordate. Orifice distinct. Bucculae infuscate, closed in front. Antennae moderately long, slender, testaceous; segment I short, moderately thick, twice as long as II; III very slender, straight, indistinctly pilose, nearly three times as long as IV; IV brownish, moderately thickened, beset with longer hairs.

Pronotum moderately transversely convex, finely pitted, truncate in front, tricarinate; median carina uniseriate, the areolae tiny; lateral carinae less elevated, subparallel; collar raised, with tiny hood; paranota moderately broad, reflexed, testaceous, biseriate in front, uniseriate behind, the outer margin rounded; triangular process testaceous, reticulated. Elytra with tips only slightly separated in repose; costal area rather broad, testaceous, mostly biseriate, triseriate in widest part, the areolae rather small; subcostal area narrow, brownish, mostly biseriate; discoidal area grayish brown to brown, extending to middle of elytra, widest beyond middle, there five areolae deep; sutural area more widely reticulated, the nervures considerably embrowned; wings fumose, longer than abdomen. Body beneath black.

Length, 2.70 mm; width, 1.00 mm.

Type (male), allotype (female), and 12 paratypes, Pichilingue, Ecuador, October 1–2, 1944; 1 paratype, El Topo, Ecuador, October 5, 1944. Separated from *L. distantis* Drake in having the costal area triseriate in widest part, narrower subcostal area, and discoidal area narrower apically.

Leptopharsa lauta, n. sp.

Small, whitish testaceous, the veins in sutural area considerably embrowned, the areolae hyaline, iridescent. Head black, with five long, slender, testaceous spines. Rostrum brown, black at tip, extending beyond middle of mesosternum; laminae low, whitish, testaceous, uniseriate. Antennae moderately long, slender; indistinctly pilose; segment I brownish black, moderately long, moderately thick, nearly three times as long as II; II slenderer, short, brown; III long, very slender, about three times as long as IV; IV moderately thickened, brown, clothed with pale hairs. Body beneath black. Legs very slender, long, yellowish brown, the tarsi dark.

Pronotum moderately convex, black, finely pitted, tricarinate; median carina foliaceous, distinctly more elevated than lateral, composed of one row of high, rectangular areolae; lateral carinae low, each composed of one row of elongate areolae. Hood rather small, slightly compressed laterally, subequal in height and length. Paranota moderately broad, distinctly reflexed, biseriate, the areolae moderately large, the outer margin rounded, beset with moderately long, bristly hairs. Triangular process of pronotum reticulated, whitish testaceous. Elytra distinctly constricted slightly beyond middle, the outer margins armed with rather long, very slender spines; costal area wide, biseriate along basal half, triseriate in widest part, the areolae rather large and not arranged in definite rows; subcostal area moderately wide, biseriate; discoidal area rather short, not reaching middle of elytra, the boundary raised, highest a little behind middle.

Length, 2.30 mm; width, 0.90 mm.

Type (male), allotype (female), and 11 paratypes, Vinces, Ecuador, October 14, 1944. This species may be separated from *L. setigera* (Champion) by its smaller size, narrower paranota and smaller hood. *L. fimbriata* (Champion) is a distinctly larger species.

Leptopharsa luxa, n. sp.

Very small, testaceous, the pronotum, collar, carinae, and discoidal, subcostal, and sutural areas brown; areolae hyaline, the areolae in sutural area infuscate with clear centers. Antennae moderately long, indistinctly pilose, testaceous; segment I brown, short, about twice as long as II; III long, about three times as long as IV; IV mostly black, slightly thickened. Head black; posterior spines testaceous, rather long, adpressed, median spine brown, shorter, directed obliquely upward. Rostrum brownish, black at tip, not quite reaching base of meso-

sternum; laminae widely separated, low, testaceous. Legs slender, testaceous, the tarsi dark. Abdomen beneath black, the sternum brown.

Pronotum moderately convex, finely pitted, tricarinate; carinae sharply raised, uniseriate, the areolae tiny; lateral carinae slightly divaricating anteriorly; collar raised anteriorly, finely areolate; paranota long, narrow, subangularly projecting in front, testaceous, biseriate, the areolae moderately large, hyaline. Elytra widening at base, widest a little beyond base, thence moderately narrowing posteriorly, slightly constricted beyond middle, the apices not overlapping in repose; costal area wide, mostly biseriate, triseriate in widest part, the areolae moderately large; subcostal area narrow, mostly biseriate; discoidal area very narrow, pointed at base and apex, biseriate or triseriate in widest part, not reaching middle of elytra, the areolae small, with whitish opaque centers; areolae of sutural area larger.

Length, 2.00 mm; width, 0.80 mm.

Type (male), allotype (female), and 1 paratype, Vinces, Ecuador, October 14, 1944.

This tiny species is not easily confused with other species of the genus. The size, color pattern of elytra, and rectangular paranota are distinguished characters. In general aspect it resembles somewhat members of the genus *Atheas* Champion.

Leptopharsa divisa (Champion)

Barcena, Guatemala, 1 specimen, November 22, 1944.

Phymacysta tumida (Champion)

Tingo María, Peru, 4 specimens, September 10, 1944; Machala, Ecuador, 2 specimens, September 27, 1944. These specimens tend to be a little larger than most specimens before us from Venezuela, Panama, Trinidad, Haiti, and Brazil. *L. malpighae* Drake from Cuba belongs to the genus *Phymacysta* Monte. *Leptopharsa cubana* Drake is a synonym of *L. malpighae* Drake.

Leptodictya bambusae Drake

Many examples taken on sugarcane, Machala, Ecuador, September 27, 1944; on *Bambusa vulgaris*, San Andrés, El Salvador, July 21, 1944, and El Porvenir, Guatemala, July 9, 1944. This species ranges from Texas to Peru and is recorded from the West Indies. It is also recorded as a pest of maize.

Leptodictya fraterna Monte

San José, Costa Rica, many specimens from bamboo, August 20, 1944. This species is closely related to *L. cretata* Champion from which it differs largely in having the basal antennal segment slightly longer and fuscous-black. The second segment is concolorous with the first.

Leptodictya ecuadoris, n. sp.

Small, black-fuscous, the antennae, paranota and legs testaceous, the pronotum, discoidal and subcostal areas brownish, the areolae of costal area within, the centers of marginal areolae, some of the areolae of subcostal area and paranota hyaline. Head with five, testaceous, very long, slender, porrect spines. The median spine longest. Antennae long, slender, indistinctly pilose; segment I short, a little stouter and about twice as long as II; III slightly more than three times as long as IV; IV slightly thickened, light fuscous, moderately long. Legs long, slender, testaceous. Rostrum extending on metasternum, yellowish brown; laminae testaceous, not widely separated.

Pronotum moderately, transversely convex, distinctly pitted, sharply tricarinate; carinae testaceous, each uniseriate, the lateral carinae parallel; hood sharply raised, highest in front, low behind, compressed laterally; paranota biseriate above (overlapping part). Elytra broad, the tips separated in repose; outer margins broadly rounded, widest before apex; costal area wide, six areolae deep in widest part, the areolae large; subcostal area uniseriate; discoidal area elongate, extending to middle of elytra, narrowed at base and apex, widest near middle, there four areolae deep. Male tending to be a little smaller than female.

Length, 3.00 mm; width, 1.75 mm–1.95 mm.

Type (male), allotype (female), and 35 paratypes, from bamboo, Vinces, Ecuador, October 14, 1944.

Differs from *L. nota* Drake in having elytra much broader at base and of different color pattern. In *L. nota* the elytra are gradually widened posteriorly.

Leptodictya laidis, n. sp.

Head dark reddish brown, convex above, with five long, slender spines; anterior pair shortest, fuscous, not quite reaching apex of first antennal segments; median spine longest, fuscous, pale at base, extending beyond middle of second segment; hind pair long, a little

shorter than median, fuscous, pale at base, directed forward, slightly divaricating anteriorly. Antennae rather long, indistinctly pilose; segment I moderately swollen, dark fuscous, about two and one-half times as long as II; II slightly slenderer, short, dark fuscous; III yellowish brown, long, slightly more than twice as long as IV; IV blackish, long, slightly thickened, slightly bowed. Bucculae wide, blackish; rostral channel deep, rather wide, the laminae brown; rostrum brown, black at tip, reaching middle of mesosternum. Abdomen brown beneath. Legs yellowish brown, the tarsi dark.

Pronotum slightly, transversely convex, coarsely pitted, tricarinate, each carina finely uniseriate, the lateral pair parallel, the median slightly more raised in front. Hood low, slightly produced in front, the areolae small, whitish, the nervelets infuscate. Paranota white-testaceous, uniseriate behind, biseriate in front. Elytra broad, roundly expanded at base, the tips separated; costal area very wide, rather widely reticulated, five or six areolae deep in widest part, the nervures mostly dark fuscous, the areolae at base and a transverse band (three areolae deep) clear, the rest of the areolae largely infuscate; discoidal area elongate, extending beyond middle of elytra, narrowed at base and apex, the areolae clear, the veins dark fuscous; sutural area, widely reticulated, the nervures dark fuscous, some of the areolae clear or not entirely infuscate. Wings smoky, nearly as long as abdomen.

Length, 3.80 mm; width, 2.10 mm–2.25 mm.

Type (male), allotype (female), and 40 paratypes, from bamboo, Villavicencio, Colombia, November 3, 1944. This species is very pretty, and the color of the elytra is difficult to describe because of the variation in fuscous color of areolae.

Leptodictya nigrosis, n. sp.

Broad, closely reticulated, dark fuscous, with a large pale spot in costal area opposite apex of discoidal area, the areolae of paranota clear. Head black, with five rather long, brownish spines. Legs slender, brownish. Rostrum brownish, reaching beyond mesosternum. Antennae moderately long, indistinctly pilose; segment I short, dark fuscous, nearly twice as long as II; II slender, yellowish brown; III long, yellowish brown, three times as long as IV; IV blackish, slightly enlarged, clothed with long hair.

Pronotum moderately, transversely convex, closely pitted; carinae foliaceous, each uniseriate, the areolae small; lateral carinae slightly convex within in front, the median a little more elevated. Hood rather small, scarcely produced in front, tentiform, the areolae whitish opaque. Paranota moderately broad, the reflexed part biseriate. Elytra very broad, rounded at base; costal area very wide, with four or five transverse nervures slightly enlarged, the areolae small, whitish or fuscous opaque; subcostal area narrow, biseriate; discoidal area large, extending beyond middle of elytra, narrowed at base and apex, widest near middle, the areolae confused in arrangement and several deep in widest part; sutural area more widely reticulated, the areolae subopaque. Body beneath blackish.

Length, 4.15 mm; width, 2.10 mm.

Type (male), allotype (female), and 4 paratypes, from bamboo, Tingo María, Peru, September 7, 1944. This species is longer than the other dark-colored members of the genus, and more closely reticulated.

Leptodictya parilis, n. sp.

Moderately large, grayish to dark-fuscous, the areolae hyaline. Head black, with five moderately long, brown spines. The median and front pair erect. Eyes large, dark reddish. Rostrum extending beyond middle of metasternum. Antennae rather long, indistinctly pilose; segment I black-fuscous, moderately long, thicker and three times as long as II; II brown, short; III very long, brown; IV dark.

Pronotum moderately, longly transversely convex, grayish fuscous, tricarinate, the carinae indistinctly areolate, moderately large, inflated, slightly produced in front. Elytra moderately wide, becoming slightly wider posteriorly. The outer margin distinctly, finely serrate; costal area moderately broad, rather closely reticulated, with three, transverse, slightly thickened nervures, the areolae not arranged in definite rows, ranging from five deep at base to seven or eight in widest part; subcostal area narrow, biseriate; discoidal area elongate, narrowed at base and apex, widest near middle, there five areolae deep; sutural area large, becoming more widely reticulated posteriorly. Wings not reaching apex of abdomen, smoky.

Length, 3.40 mm; width, 1.60 mm.

Type (male), from bamboo, San Andrés, El

Salvador, July 21–26, 1944. This species with dark fuscous nervures and clear areolae is probably most closely akin to *L. olyrae* Drake but readily separated by the longer hood, longer first antennal segment, lower carinae, more longly convex pronotum and differently shaped elytra. In addition to other characters, the hyaline areolae separate it from other dark-colored species with more or less clouded areolae.

Leptodictya lucida, n. sp.

Large, stramineous, the paranota pale, the areolae hyaline, iridescent. Head brown, with five long spines; anterior pair shortest, directed forward, extending a little beyond middle of first antennal segments; median spine very long, extending to tip of first antennal segments; hind pair long, divaricating toward tips. Antennae indistinctly pilose, moderately long; segment I moderately long, thick, about two and one-half times as long as II; III long, slender, slightly more than twice as long as IV, the latter dark fuscous. Legs slender, yellowish brown, the tarsi dark. Rostrum reaching a little beyond mesosternum. Body beneath brown.

Pronotum moderately, transversely convex, tricarinate, the carinae indistinctly areolate, the median slightly more elevated in front; lateral carinae slightly divaricating anteriorly; paranota moderately wide, wider in front, mostly biseriate. Elytra very broad, divaricating posteriorly, the tips separated in repose, the outer margin broadly rounded; costal area very wide, with three, transverse, slightly thickened nervures, the areolae not arranged in definite rows, about eight or nine deep in widest part, those within along discoidal area smaller; subcostal area very narrow, uniseriate; discoidal area long, narrow, widest near middle, there five areolae deep.

Length, 3.55 mm; width, 2.20 mm.

Type (male), allotype (female), and 1 paratype; from bamboo, Tingo María, Peru, September 7, 1944. Separated from *L. sodalatis* Drake by the shortly pilose antennae, much narrower paranota, differently shaped elytra with smooth lateral margins.

Leptodictya decoris, n. sp.

Moderately large, broad, rather widely reticulated. Head black, convex above, with five brownish spines; front pair extending a little beyond middle of first antennal segments; median and hind pair extremely long, directed obliquely forward. Antennae testaceous, indistinctly pilose, the last segment dark fuscous; segment I rather short, thicker and about twice as long as IV; IV slightly thickened, long, clothed with longer hairs. Rostrum brownish, dark at tip, extending between intermediate coxae. Legs slender, testaceous, the tarsi dark. Body beneath brown to black. Orifice distinct.

Pronotum moderately, transversely convex, closely pitted, polished, the paranota, carinae, collar and hood whitish, the hind triangular process of pronotum testaceous to whitish; paranota moderately wide, with single row of transverse, rectangular areolae; hood small, narrow, slightly projecting anteriorly; carinae low, indistinctly areolate, the median slightly higher in front; lateral carinae faintly diverging anteriorly. Elytra broad, broadly rounded at base white-testaceous, the outer nervure thickened and infuscate, the areolae clear, the veinlets along the outer margins sometimes partly infuscate; costal area broad, with six to seven irregular rows of areolae in greater part; subcostal area narrow, biseriate; discoidal area elongate, narrowed at base and apex, widest near middle, there four areolae deep; sutural area widely areolated.

Length, 3.85 mm; width, 2.00 mm.

Type (male), allotype (female), and 14 paratypes, from bamboo, Tingo María, Peru, September 7, 1944. This very pretty species may be separated from congeners by color, low carinae and broad elytra. The tips of the elytra are moderately separated in repose, the outer margins finely serrate and the areolae somewhat iridescent.

Ulocysta, n. gen.

Distinctly lacy, the areolae large and hyaline. Hood very large, covering base of head and extending posteriorly so as to conceal most of hind process of pronotum, united beneath on triangular process with median carina; median carina foliaceous, arising behind disc and extending a little beyond hind margin of hood. Lateral carinae absent. Paranota moderately wide, foliaceous, moderately reflexed. Head short, armed with five spines. Antennae long, slender; segment I very long, stoutest; II very short; III longest, slenderest; IV very long, half the length of III, slightly thickened. Buc-

culae rather short, reticulated, closed in front. Rostral channel wide; laminal low; rostrum long. Legs slender, rather long. Orifice atrophied. Elytra long, divaricating posteriorly, apices widely separated in repose; discoidal area short, not extending to apex of abdomen. Marginal nervure of elytra and median longitudinal nervure of hood thickened.

Genotype, *Ulocysta praestabilis*, n. sp.

This genus may be separated from *Ambycysta* Drake and Hurd by the much larger hood, unicarinate pronotum, long first and fourth antennal segments and short discoidal area of elytra; and from *Megalocysta* Champion by the long first and fourth antennal segments, raised posterior portion of hood, slender legs and antennae, thinner nervures of reticulations and short discoidal area. The genus *Alloithucha* Drake has much shorter antennal segments and differently formed hood and triangular process of pronotum.

Ulocysta praestabilis, n. sp.

Moderately large, the areolae hyaline, the elytra strongly divaricating posteriorly, yellowish brown, some of the veins darker, head black, the spines testaceous, the median distinctly longer than others. Rostrum brown, extending beyond middle of mesosternum. Body beneath brown. Legs long, very slender, brownish. Antennae long, very slender; segment I brown, about twice as long as the width of head across eyes; II short, brown, slenderer; III yellowish brown, indistinctly pilose, less than twice the length of IV; IV very long, slightly thicker, clothed with longer hairs, distinctly longer than I, becoming black apically. Hood extremely large, somewhat pyriform, twice as long as high, inflated, widely reticulated, testaceous, the areolae hyaline, the median nervure straight, thick and dark; median carina clouded behind, there two areolae high; two very elongate areolae beneath hood. Paranota biseriate, the areolae moderately large, elytra strongly divaricating posteriorly, with marginal and some of the oblique nervures somewhat darkened, the areolae large and hyaline; discoidal area scarcely extending beyond apex of hind pronotal process, mostly biseriate, widest a little in front of apex; costal area mostly biseriate, triseriate in widest part; subcostal area narrower, mostly biseriate; sutural area widely reticulated.

Length, 3.20 mm; width (behind hood), 1.90 mm.

Type (female) and allotype (male), San José, Colombia, November 11, 1944.

Dicysta hollandi Drake

Pucallpa, Peru, 17 specimens, September 5, 1944.

Dicysta vitrea Champion

Tingo María, Peru, 10 specimens, September 10, 1944.

Gargaphia nigrinervis Stål

Tingo María, Peru, 19 specimens, September 10, 1944; San José, and Villavicencio, Colombia, many specimens, November 1944.

Gargaphia seorsa, n. sp.

Very similar in size, color marking and appearance to *G. serjaniae* Drake and Hambleton and differs in having longer spines on head, the elytra broadly ovate, and the paranota expanded laterally at anterior end, there two or three areolae deep. Rostrum reaching beyond middle of mesosternum. Head with five very long, slender spines, the median spines reaching beyond apex of first antennal segment, the front pair a little shorter, the hind pair very long. Paranota rather broad, mostly triseriate, the outer margin rounded, the front margin obliquely expanded. Hood moderately large, slightly smaller than in *G. serjaniae*. Body beneath brown. Elytra broad, the outer margin broadly rounded, widest in front of middle; costal area broad, mostly triseriate, quadriseriate in widest part. Margins of paranota and elytra finely serrate. Other characters very similar to *G. serjaniae*.

Length, 4.25 mm; width, 1.65 mm.

Type (male), allotype (female) and 18 paratypes, Aguaytia, Peru, Sept. 6, 1944, and 13 paratypes, Pucallpa, Peru, Sept. 6, 1944. The paranota are roundly expanded and without distinct anterior margin; the elytra are widest a little before the apices in repose.

Gargaphia neivai Drake and Poor

Pichilingue, Ecuador, 6 specimens, October 15, 1944. Known heretofore from Paraguay.

Gargaphia opima Drake

Numerous examples, Aguaytia and Tingo María, Peru, taken on *Canavalia ensiformis;* 1

specimen, Villavicencio, Colombia, November 3, 1944. *Gargaphia inca* Monte, Rev. Brazil. Biol. 3 (1): 105, fig. 1, 1943, is suppressed as a synonym of *M. opima*.

Gargaphia paula Drake and Hambleton

Tingo María, Peru, 18 specimens, September 10, 1944. Known heretofore only from the Canal Zone, Panama.

Gargaphia acmonis, n. sp.

Moderately elongate, distinctly widening posteriorly. Head black, with five long, testaceous spines, the anterior pair shortest. Antennae long, indistinctly pilose; segment I moderately long, rather stout, fuscous-black, three times as long as II; II short, testaceous, slenderer; III slender, testaceous, approximately three times as long as IV; IV largely fuscous-black, moderately long, clothed with longer hairs. Rostrum extending to middle of mesosternum. Bucculae closed in front. Orifice prominent. Legs long, slender, testaceous, the tarsi dark.

Elytra gradually widening posteriorly, the tips somewhat separated in repose; costal area moderately wide, gradually widening posteriorly, testaceous, uniseriate along basal half, biseriate in widest part, the areolae clear and moderately large. Other characters of elytra and pronotum very similar to *G. lunulata* (Mayr).

Length, 3.30 mm; width, 1.30 mm.

Type (male), allotype (female), and 10 paratypes, Tingo María, Peru, September 10, 1944; also 5 paratypes, San José, Colombia, November 11, 1944; and 1 paratype, Río Rimac, Peru. The shape of the elytra and uniseriate basal half of costal area separate this species from *G. lunulata* (Mayr), its nearest relative.

Corythaica costata Gibson

Many examples, Salinas and Machala, Ecuador, September and October 1944; several specimens, Villavicencio, Colombia, November 13, 1944.

Corythaica cyanthicollis (Costa)

Tingis cyanthicollis Costa, Ann. Mus. Zool. Nap. 1864 (2): 146, fig. 2.
Leptopharsa passiflorae Berg, Hemip. Arg. Add. Emend. 1884: 102.
Corythaica cyanthicollis Drake and Poor, Inst. Mus. Univ. La Plata 3: 108. 1938.
Corythaica passifloriae Monte, Papeis Avulsos São Paulo 1942: 110.

San José, Colombia, many specimens, November 11, 1944. This species is one of the commonest and most widely distributed tingitids in Neotropical America and one of the most confused species in the literature. Monte, *loc. cit.*, has greatly added to this confusion, and most of his remarks are inept because he has failed to study carefully Costa's figure of *Tingis cyanthicollis*.

Corythucha gossypii (Fabricius)

Barcena, Guatemala, many examples, November 22, 1944; also many specimens from San Andrés, El Salvador, July 21–26, 1944; Pichilingue, Ecuador, October 1–2, 1944; and Managua, Nicaragua, August 1944. This insect is a pest of the cotton plant, eggplant, and pigeon pea.

Corythucha decens Stål

Los Cerritos, Guatemala, many specimens, July 5, 1944.

Corythucha nocentis Drake and Hambleton

Machala, Ecuador, many specimens, September 27, 1944.

Corythucha deceptiva Drake

Santa María de Jesús, Guatemala, many specimens, November 14, 1944.

Corythucha seguyi Drake

Tingo María, Peru, 5 specimens, September 7, 1944.

Corythucha serta, n. sp.

Moderately large, testaceous, some spots on paranota, hood, tumid elevation of elytra and a transverse band near base of costal area brown to black-fuscous, the areolae hyaline. Hood moderately large, constricted near the middle, narrowed in front, inflated behind, the hind portion about as high as wide. Median carina foliaceous, slightly higher in front, mostly uniseriate; lateral carinae not very high, gradually elevated anteriorly, terminating some distance from hood. Paranota moderately large, the outer margin and some of the veinlets beset with short spines. Elytra slightly constricted beyond middle, with rather large tumid elevation; costal area wide, with three rows of rather large areolae, the areolae in transverse band much smaller (except outer

row) and more numerous. Antennae testaceous, moderately long, beset with very long, stiff hairs, the fourth segment embrowned. Bucculae, rostral laminae and body beneath black. Rostrum brown, extending to middle of mesosternum. Legs brownish, the tibiae testaceous.

Length, 3.85 mm; width, 2.25 mm.

Type (male), allotype (female), and 40 paratypes, from an unidentified ornamental tree, Lake Atitlán, Guatemala, July 9, 1944. Related to *C. decepta* Drake and *C. setosa* Champion but with larger tumid area of elytra and with hood fully twice as large. The hood is much smaller than in *C. globigera* Breddin or *C. unifasciata* Champion. In general aspect *C. serta* resembles more closely *unifasciata*.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY

1236TH MEETING

The 1236th meeting was held in the Cosmos Club Auditorium, October 14, 1944, President STIMSON presiding.

Program: GEORGE A. GAMOW, George Washington University: *Weizsacker's planetary theory.*—It was pointed out that, although this theory had been published in Germany, the speaker's copy was one of few that had probably been received in this country because of the war. Although the published theory was incomplete in details and possibly open to certain criticisms, the speaker considered it worthy of consideration and perhaps of further development. (*Secretary's abstract.*)

Mr. A. J. SCHNEIDEROV presented an informal communication on his planetary theory.

1237TH MEETING

The 1237th meeting was held in the Cosmos Club Auditorium, October 28, 1944, President STIMSON presiding.

Program: J. BARKLEY ROSSER, Cornell University: *Many-valued logics.*—The "Law of the Excluded Middle" to the effect that every exact statement is necessarily either true or false is not an absolute law of nature which cannot be transgressed. On the contrary, it is merely a habit of thought of the human race. There exist orderly systems of reasoning which flatly deny this principle. Such a system was discussed with some illustrative examples. Although this system is violently contradictory to accepted tenets of logic, it is quite consistent in itself, and could presumably be used as a basis for scientific thought. It appears to contain a mathematics of a most unfamiliar sort, which nevertheless contains certain of the standard features of the familiar mathematics. In a certain sense, one can say that this new mathematics lacks the "sharp edges" of the old, and this suggests the possibility that, when more is known of the new mathematics, it may be a useful instrument for the treatment of quantum mechanics, which seems to be a sort of physics without "sharp edges." (*Author's abstract.*)

J. ALLEN HYNEK, Perkins Observatory, Ohio Wesleyan University: *The "science" of astrology.*—From an astronomer's viewpoint, the relatively widespread recognition of popular acceptance of belief in astrological precepts is disturbing and out of keeping with the scientific enlightenment characteristic of the present day. Recognizing the possible need for an objective demonstration of the fallacy of certain concepts held by a large part of the astrologically inclined, the writer has in his paper presented a statistical analysis of several thousand cases taken from the "American Men of Science." An analysis of the birth date frequency and the "aspects" of the planet Mercury to all other planets demonstrates by standard statistical techniques that the probability of favorable zodiacal positions of Mercury (astrologically denotes superior mental abilities) in the horoscopes of "Men of Science" is that given by the ordinary laws of chance. It is hoped that such an objective test might be useful as a classroom example. (*Author's abstract.*)

1238TH MEETING

The 1238th meeting was held in the Cosmos Club Auditorium, November 11, 1944, President STIMSON presiding.

Program: H. A. MARMER, U. S. Coast and Geodetic Survey: *Mean sea level.*—The level of the sea at any point is subject to the disturbing influence of various agencies, but

principally of tide, wind, and weather. Since the rise and fall of the tide is periodic, with a period of approximately 24 hours, the effect of the tide is practically eliminated by averaging the hourly heights of sea level throughout a day. When this is done, it is found that sea level varies from day to day, month to month, and year to year. Roughly it may be said that from day to day the variations are measured in feet, from month to month in tenths of a foot, and from year to year in hundredths of a foot.

From theoretical considerations, sea level should show a periodic variation dependent on the longitude of the moon's node which has a period of 18.6 years. Hence a determination of mean sea level as the average of the hourly measurements over a period of 19 years may be taken as constituting mean sea level. But for precision it is necessary to specify the period of 19 years, for the observations show a slow secular change. Along the Atlantic coast of the United States, for example, sea level for the past 20 years has been rising at the rate of about one one-hundredth of a foot per year. (*Author's abstract.*)

1239TH MEETING

The 1239th meeting was held in the Cosmos Club Auditorium, November 25, 1944, Vice-President WAIT presiding.

Program: E. O. HULBERT, Naval Research Laboratory: *Optics of distilled water and sea water.*—By means of a spherical scattering flask and a 12-foot absorption tube the scattering and absorption coefficients throughout the visible spectrum were measured in the laboratory of samples of distilled water, of Chesapeake Bay, and of the Atlantic Ocean.

Subtracting the absorption of pure water from that of the Bay water left a residual blue absorption due to the plankton content of the Bay. The plankton color would therefore be termed "yellow" or "amber." This combined with the red absorption of pure water caused the Bay to be green, as observed. The result supported the conclusion that the deep blue of tropical ocean areas far from land and the dark gray or green gray of high latitude sea areas far from land are due to the known scarcity and abundance of pelagic planktonic material in the respective areas.

The laboratory optical coefficients were introduced into the theoretical equations of a former paper (Journ. Optical Soc. Amer. 33: 42–45. 1943) and the amount of daylight emerging upward from the Bay and the sea were calculated for various states of the sky ranging from clear to overcast. The theoretical values of the reflectivity of a calm surface of the sea and the Bay increased from about 0.025 to 0.055 as the cloudiness increased from zero to completely overcast. In approximate agreement with theory, values of the reflectivity of the sea and the Bay, observed in moderate weather from a boat and an airplane, were 0.02 to 0.03 for a cloudless sky and 0.05 to 0.06 for a cloudy sky. (*Author's abstract.*)

1240TH MEETING

The 1240th meeting, a joint meeting with the Washington Academy of Sciences, was held in the Cosmos Club Auditorium, November 30, 1944.

Program: ROBERT H. MONTGOMERY, Foreign Economic Administration: *The impact of technology on community life.*

1241ST MEETING

The 1241st meeting, constituting the 74th annual meeting, was held in the Cosmos Club Auditorium, December 9, 1944, President STIMSON presiding.

The Treasurer reported that the income from dues and interest on investments was $1,483.90 and that the expenditures exclusive of investments was $1,126.88, leaving a net surplus of $357.02 on ordinary expenses. The ordinary expenses were at the rate of $3.30 per member. The total estimated assets of the Society as of December 1, 1944, were $15,721.21.

The Secretaries' joint report showed an active membership as of December 1, 1944, of 339, of whom the following 29 were new members: HAROLD V. ARGO, MARY FRANCES ARGO, PAUL F. BARTUNEK, E. H. BRAMHALL, JOSEPH S. BROCK, EDWIN LOUIS CROW, GILBERT H. CURL, HASKELL B. CURRY, NORMAN DAVIDS, CHARLES A. DOUGLAS, JACQUES DUTKA, RUSSELL H. GOFF, LAURENCE B. HEILPRIN, FRED KELLER, JR., E. H. KENNARD, MYRON KIRSTEIN, LOUIS LANDWEBER, SAMUEL LEVY, JEAN SYLVE MENDOUSSE, MARLIN L. MILLER, MARTHA G. MORROW, FRANZ H. RATHMANN, EDGAR O. SEAQUIST, WILLIAM J. SETTE, ALAN H. SHAPLEY, RALPH R. SHAW, BENJAMIN

SUSSHOLZ, CHARLES A. WHITTEN, and M. L. ZIMMER.

The Secretaries reported the deaths of J. FRANKLIN MEYER and JESSE PAWLING.

Following the report of the Committee on Elections, the following officers were declared elected for the year 1945: *President*, GEORGE R. WAIT; *Vice-Presidents*, C. L. GARNER and FRANCIS M. DEFANDORF; *Treasurer*, FRANCIS E. JOHNSTON; *Recording Secretary*, KENNETH L. SHERMAN; *Members-at-Large of the General Committee*, WALTER L. CHENEY, JOHN W. MCBURNEY, and G. B. SCHUBAUER.

Program: NICHOLAS P. SETCHKIN, National Bureau of Standards: *The ignition temperature of liquids.*—The self-ignition temperature of a combustible mixture can be defined as the lowest initial temperature from which, under given conditions, the exothermic reaction within the mixture will raise the temperature to a point where ignition, evidenced by flame or explosion, will occur. In our tests made at atmospheric pressure, an optimum charge of the liquid, as determined by trial, was injected into a flask raised to a constant uniform temperature, the course of the reaction being indicated by temperature changes within the resulting gas-air mixture. Depending on whether ignition was obtained, tests were made at higher or lower initial temperatures until the lowest ignition threshold was determined.

The lag between the introduction of the charge and moment of ignition increased with decrease in initial temperature and, at the level of the self-ignition temperature, varied as between different liquids from a few seconds to 20 minutes.

Ignition flasks of 15,000, 1,000, and 200 ml capacity were applied in the tests with variations in details of heating and insulation. Most of the tests were made in the 1,000 ml equipment with which temperature uniformity within 1°C. was attained. Sharp distinction between ignition and non-ignition within a few degrees C. difference in initial flask temperature was observed for most liquids. Being that only the part of the heat from the ignition reaction not lost to the flask wall and surroundings is available for raising the temperature of the reacting mixture, there should be expected an increase in ignition temperature with decrease in size of ignition chamber, but this effect was not indicated as very marked for the range in size indicated above. Thus, for a sample of motor gasoline, respective self-ignition temperatures of 240°, 243°, and 248°C. were obtained in these chambers, having corresponding surface-to-volume ratios of 0.20, 0.48, and 0.83. (*Author's abstract.*)

1242D MEETING

The 1242d meeting was held in the Cosmos Club Auditorium, January 6, 1945, President WAIT presiding.

The retiring President, H. F. STIMSON, of the National Bureau of Standards, delivered his presidential address on the subject *The measurement of some thermal properties of water.* This address was published in this JOURNAL (**35**: 201–217. 1945).

1243D MEETING

The 1243d meeting was held in the Cosmos Club Auditorium, January 20, 1945, President WAIT presiding.

Program: JOHN K. BOOSAHDA, Naval Ordnance Laboratory: *Plastics—today and tomorrow.*—A general survey of the plastics industry was presented. A brief discussion of its growth, of types of materials available, and of the methods of processing was followed by a motion picture on molding. The most prolific period in the commercial development occurred in the last decade although the first commercial application of a plastics material dates back 75 years. Plastics were discussed under two main types, depending on the nature of the change undergone when exposed to heat: the thermosetting which undergo a chemical change and the thermoplastic which undergo a physical change. Thermosetting resins include the phenolics, the aminoplasts, and the more recent polyesters. The thermoplastic resins include the cellulosics, the vinyls, acrylics, polystyrene, and polyamides. The former are amenable to compression and transfer molding and to laminating and casting; the latter may be continuously molded by injection and extrusion. Owing to the intense development in recent years, tomorrow will bring many materials for wide use. A very interesting exhibit of plastics materials and products and an informal discussion period followed adjournment. (*Secretary's abstract.*)

1244TH MEETING

The 1244th meeting was held in the Cosmos Club Auditorium, February 3, 1945, President WAIT presiding.

Program: E. H. VESTINE, Department of Terrestrial Magnetism, Carnegie Institution of Washington: *The geographical distribution of aurora.*—A new derivation of the frequency of aurora in days per year in various geographic positions was described, as found on the basis of a revision of earlier data of Fritz, and inclusion of subsequent data of the past 70 years, for the Northern Hemisphere. Isochasms for the Southern Hemisphere were also estimated. Maps showing lines of average equal hourly frequency of aurora were found in good general correspondence with expectations indicated for average current-lines in the atmosphere during geomagnetic bays. (*Author's abstract.*)

Mr. A. J. SCHNEIDEROV presented an informal communication on the gravitational constant.

1245TH MEETING

The 1245th meeting was held in the Cosmos Club Auditorium, February 17, 1945, President WAIT presiding.

Program: DONALD H. ANDREWS, Johns Hopkins University: *Explorations near absolute zero.*—Recent developments in the technique of adiabatic cooling through demagnetization, as first applied by Giaque, have pushed the limit of attainable temperature to within 0.005° of absolute zero. The thermodynamic significance of the low temperature region is illustrated in the fact that the calculated vapor pressures of all known substances drop far below the negative hundredth power of ten atmospheres. One might expect this to be a region where no equilibrium of any kind could be attained, a graveyard of thwarted free energy. Paradoxically, in the region within a few degrees of absolute zero, there have been discovered two of the most mobile phenomena ever found, superconductivity and the superfluidity of helium. In superconductivity and its resultant persistent currents, we have one of the nearest approaches to ordered macroscopic perpetual motion, occurring, strangely enough, in what might have been expected to be the region of perpetual rest. In superfluidity, we have an example of almost a hundredfold abnormally large thermal-conductivity and small viscosity in a fluid which appears to have the ordered structure of a solid. These effects appear to be related to the quantization of energy and the resultant enhancing of phenomena especially dependent on the character of the statistics controlling the behavior of the particles. The possible use of these phenomena to provide supersensitive instrumental analysis of other phenomena at both low and high temperatures has been illustrated by the construction of a bolometer employing a superconducting filament as the radiation receiver. By using radiation sources at temperatures in the neighborhood of 25° K, it has been shown that such a bolometer will detect increments of energy of the order of 5×10^{-4} ergs per second and evidence has been obtained for the validity of the fourth power radiation law for wave lengths in the neighborhood of 100 microns. (*Author's abstract.*)

Mr. MICHAEL GOLDBERG presented an informal communication concerning the diameter of cylinders and spheres, using models in a demonstration.

1246TH MEETING

The 1246th meeting was held in the Cosmos Club Auditorium, March 3, 1945, President WAIT presiding.

Program: DOUGLAS F. WINNEK, The Winnek Laboratories, Mount Vernon: *Trivision—a direct-vision color stereograph.*—The method being developed in this laboratory uses standard photographic film, the back of which is processed, in effect forming many small cylindrical lenses. For exposure the emulsion side of the film is turned away from the camera lens. The problems and progress of development were outlined and some of the possibilities and probable uses were indicated. Sample photographs of various subjects created considerable interest and indicated real accomplishment. (*Secretary's abstract.*)

1247TH MEETING

The 1247th meeting was held in the Cosmos Club Auditorium, March 17, 1945, President WAIT presiding.

Program: A. G. MCNISH, Department of Terrestrial Magnetism, Carnegie Institution of Washington: *The odograph.*—The vehicular odograph is an instrument for automatically making a map of the course followed by a

vehicle. It was developed in its experimental stages at the Department of Terrestrial Magnetism of the Carnegie Institution of Washington under a contract with the Office of Scientific Research and Development in accordance with a directive from the Office of Chief of Engineers. Engineering the device for production was accomplished by the Monroe Calculating Machine Co. and by the International Business Machines Co., which companies later manufactured it for the Army.

The device consists of a magnetic compass, which is "followed" by a photoelectric system, and an integrating unit. Information regarding heading of the vehicle and information regarding distance traveled are fed into the integrating unit from the compass and the speedometer cable, respectively. Motion of the vehicle is mechanically resolved into north-south and east-west components by the integrator. Movements proportional to the distance travelled in each of these directions is brought up to a pair of perpendicular lead screws which drive a stylus on a map paper. In this way the course followed by the vehicle is accurately portrayed.

Experimental tests show that under normal conditions an accuracy of from one to two per cent can be expected from the device, better results not being infrequent, and even under severe operating conditions the errors remain small enough that the instrument serves many useful functions. (*Author's abstract.*)

1248TH MEETING

The 1248th meeting was held in the Cosmos Club Auditorium, March 31, 1945, President WAIT presiding.

Program: A. H. STONE, Geophysical Laboratory, Carnegie Institution of Washington: *Electrical networks and "squaring the square."*—This talk summarized a paper by R. L. BROOKS, C. A. B. SMITH, A. H. STONE, and W. T. TUTTE ("On the dissection of rectangles into squares"), which appeared in the Duke Mathematical Journal, vol. 7, 1940. The problem considered is this: Can a square be dissected into a finite number of smaller square pieces, no two of which are equal? More generally, what kinds of rectangles can be dissected into unequal squares ("squared")? Rather unexpectedly, the complete solution follows from considerations of classical applied mathematics. Any "squaring" of a rectangle can be represented by a steady flow of electricity in a network, the currents being proportional to the sides of the squares. Considerations of symmetry in the network enable one to construct different "squarings" of the same rectangle, and thus to "square" a square in infinitely many different ways. It follows that a rectangle can be "squared" if and only if its sides are commensurable. "Squared" rectangles can have as few as 9 square pieces, but no fewer. A square can be dissected into 26 unequal squares, possibly fewer. (*Author's abstract.*)

Mr. L. B. TUCKERMAN presented an informal communication on adding strength to structural parts by cutting away material.

1249TH MEETING

The 1249th meeting was held in the Cosmos Club Auditorium, April 14, 1945, President WAIT presiding.

Mr. SILSBEE, Chairman of the Joseph Henry Lecture Committee, introduced JOHN VON NEUMANN, of the Institute for Advanced Study, Princeton, who delivered the fourteenth Joseph Henry lecture, *Causality, statistics, and quantum mechanics.* It is expected that this lecture will be published in this JOURNAL.

1250TH MEETING

The 1250th meeting was held in the Cosmos Club Auditorium, April 28, 1945, President WAIT presiding.

Program: WILLIAM F. BROWN, JR., Naval Ordnance Laboratory: *Ferromagnetic domains.*—The Weiss "molecular field" theory explained the large magnetization of ferromagnetic materials but predicted spontaneous magnetization even in zero field. To overcome this difficulty, Weiss postulated that the material really is spontaneously magnetized over microscopic regions or "domains," which in zero field are magnetized in different directions. Despite quantum-theory improvements on Weiss's theory, domains must still be postulated.

At small fields, the domains are magnetized along "directions of easy magnetization" determined by crystalline anisotropy; the field causes a larger volume to be magnetized in some of these directions and a smaller volume in others. At large fields, the spontaneous magnetization rotates toward the field direction. The second stage is reversible and therefore

easily handled theoretically. The first stage is more difficult to interpret. Experiments on the Barkhausen effect, powder patterns, and alloys under tension suggest that one domain grows at the expense of another by displacement of the "wall" between them. A theoretical study of the "wall" supports this idea. Walls undergo small displacements reversibly, but ultimately they reach unstable positions and move irreversibly through finite distances; this is the mechanism of the Barkhausen effect and hysteresis. (*Author's abstract.*)

Mr. A. H. MEARS presented an informal communication on an instrument developed for obtaining data for statistical study and its use in connection with a wind turbine for generating power.

1251ST MEETING

The 1251st meeting was held in the Cosmos Club Auditorium, May 12, 1945, President WAIT presiding.

Program: STERLING B. HENDRICKS, Bureau of Plant Industry, Soils, and Agricultural Engineering: *Photoperiodic flowering response of plants.*—Floral development in plants as influenced by length of day was discussed in detail and illustrated by examples within the experience of the audience. Results recently obtained by H. A. BORTHWICK, M. W. PARKER, N. J. SCULLY, and the speaker were presented. Spectroscopic equipment used to determine the action spectrum for floral initiation in Biloxi soybean was described.

The following theory consistent with past observations was advanced: A material forming in the chloroplasts during the dark period diffuses from the leaf to the growing point and, between certain concentration limits, causes floral development. Light absorbed by chlorophyll partially destroys this material at its source by sensitized oxidation. At high concentrations, such as produced in long-day plants under short-day conditions, the material inhibits flowering. Continuous illumination of a long-day plant reduces the concentration of the material to the critical range. This range is attained in short-day plants only when the night is adequately long. (*Author's abstract.*)

1252D MEETING

The 1252d meeting was held in the Cosmos Club Auditorium, May 26, 1945, President WAIT presiding.

Program: WILLIAM B. KOUWENHAVEN, Johns Hopkins University: *Electric shock—physiological manifestations and treatment.*—The speaker outlined the problems relating to electric shock, discussed the effects of electric currents passing through the body, and described methods of resuscitation. The importance of immediate application of artificial respiration methods and their uninterrupted and continued use was stressed. The method of applying artificial respiration atop the poles of power lines was given and illustrated in some detail. Results were given of comparisons between this method and the normal method by which the patient is first brought down the pole and placed prone on the ground. (*Secretary's abstract.*)

Mr. L. B. TUCKERMAN presented an informal communication relating to the equation of a curve like that at the seams of the cover of a baseball.

KENNETH L. SHERMAN,
Recording Secretary.

BACK ISSUES OF JOURNAL WANTED

During the past several years the Custodian and Subscription Manager of Publications has received from various members of the Academy many numbers of the JOURNAL that were no longer needed by them. These contributions have made it possible to assemble several complete sets. At the present time there is urgent need for those issues of the JOURNAL in Volumes 1 to 10, inclusive. Accordingly, members who may have any such numbers that they no longer wish to keep are urged to send them to FRANK M. SETZLER, Custodian and Subscription Manager, U. S. National Museum, Washington 25, D. C.